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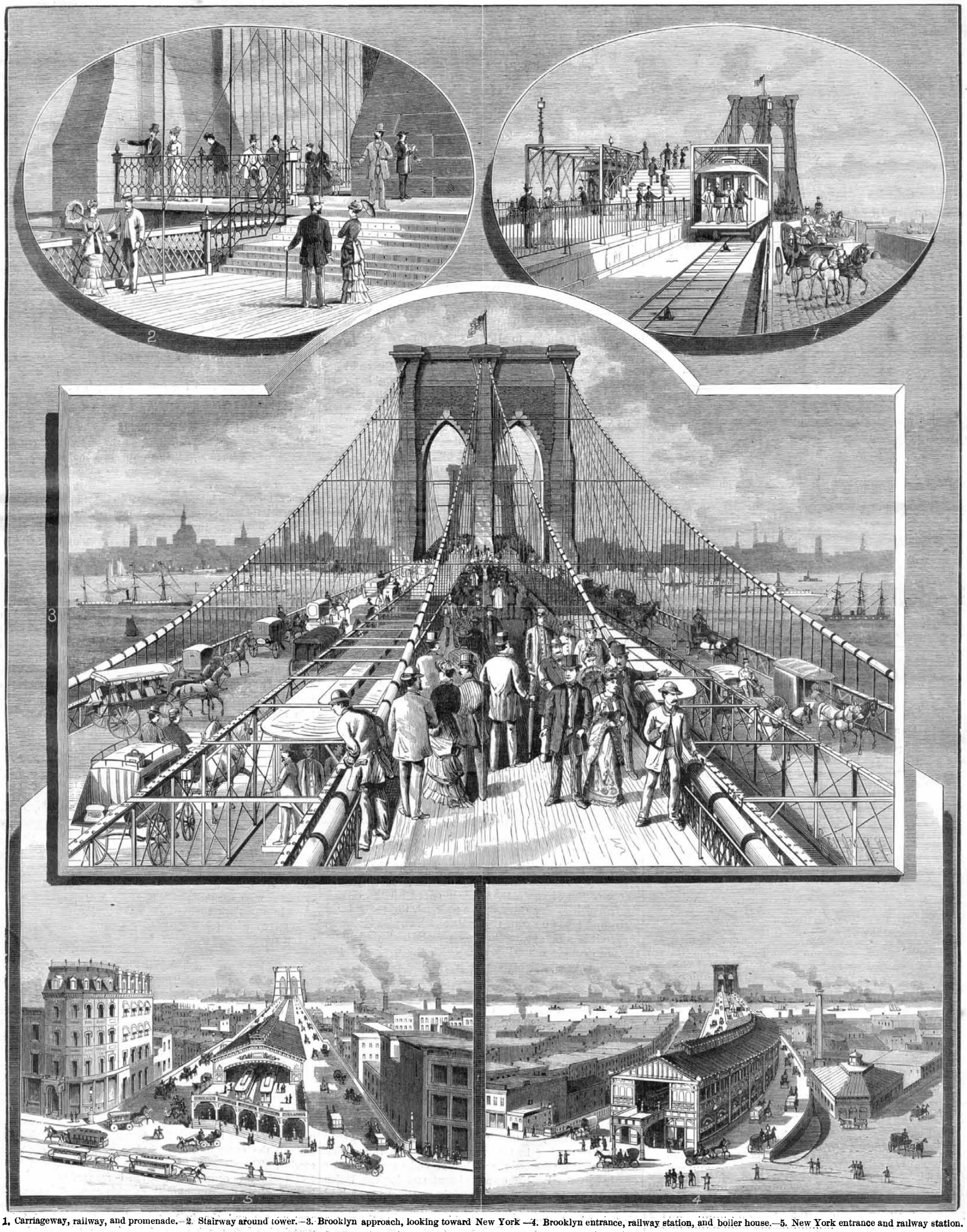

1. Carriageway, railway, and promenade.—2. Stairway around tower.—3. Brooklyn approach, looking toward New York.—4. Brooklyn entrance, railway station, and boiler house.—5. New York entrance and railway station.

OPENING OF THE GREAT SUSPENSION BRIDGE BETWEEN NEW YORK AND BROOKLYN.

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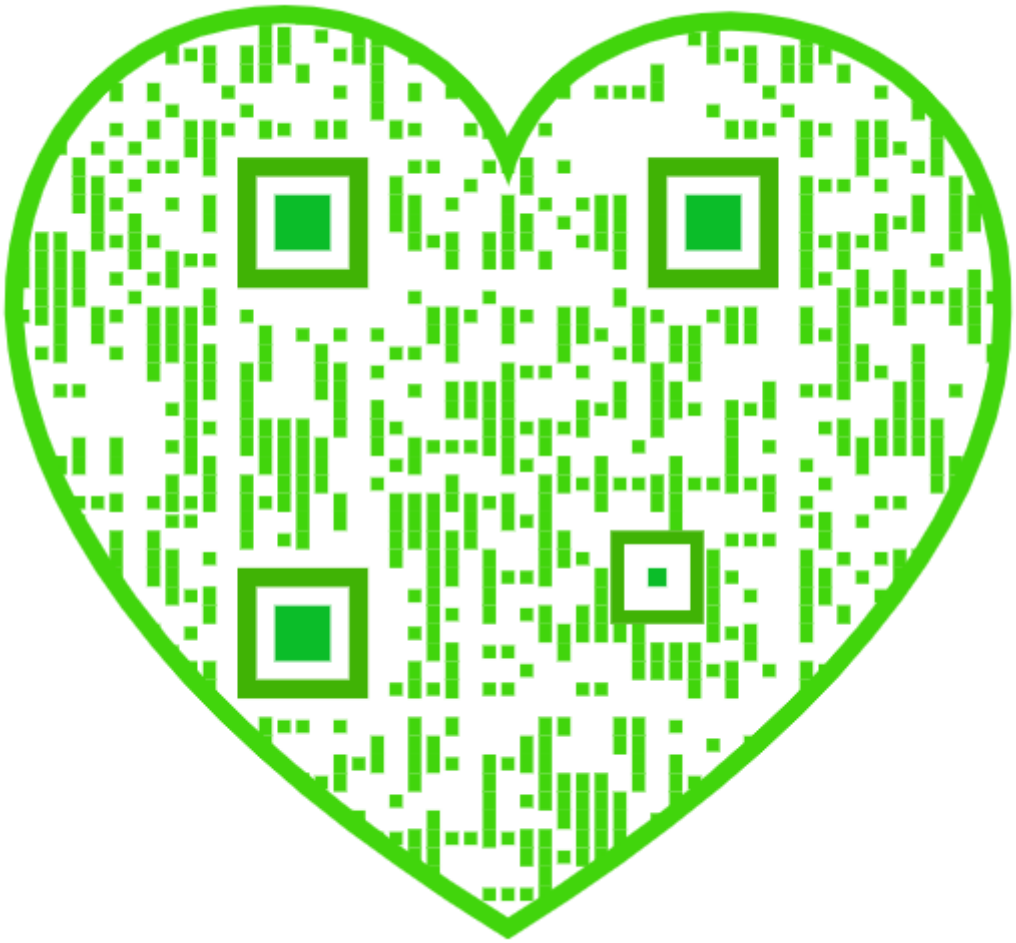

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NEW YORK, SATURDAY, MAY 26, 1883.

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OPENING OF THE GREAT BRIDGE.

The time of our going to press slightly antedates the day of the opening of the great bridge connecting New York and Brooklyn; but our readers will be interested in knowing the intended order of proceedings.

The initial ceremonies have been appointed to take place in the Brooklyn station of the bridge on Sands Street, at 2 P. M., on Thursday, May 24, 1883.

The marshal of the day will be Major-General James Jourdan. The President of the United States and Cabinet, the Governor of the State of New York and staff, with others, will be escorted from the Fifth Avenue Hotel to the New York anchorage by the 7th Regiments, Colonel Emmons Clark commanding, and there received by the trustees and escorted to the Brooklyn anchorage, from which point the 23d Regiment, Colonel Rodney C. Ward commanding, will act as escort to the Brooklyn approach.

Seats will be reserved for the President and Cabinet, the Governor and staff, United States Senators, members of Congress, Governors of other States, members of the Legislature, the Common Councils of New York and Brooklyn, city and county officials of New York and Brooklyn, Army and Navy, the National Guard, the Press, especially invited guests, and the employes of the bridge.

At 2 o'clock the exercises will begin at the bridge station, Hon. James S. T. Stranahan presiding. The programme is as follows:

1. Music..... 23d Regiment Band.
2. Prayer..... Bishop Littlejohn.
3. Presentation address in behalf of the trustees, William C. Kingsley, vice-president.
4. Acceptance address in behalf of the City of Brooklyn, Seth Low, Mayor.
5. Acceptance address in behalf of the City of New York, Franklin Edson, Mayor.
6. Oration..... Abram S. Hewitt.
7. Oration..... Richard S. Storrs, D D.
8. Music..... 7th Regiment Band.

In the evening a grand display of fireworks from the bridge takes place, and also a reception, at the Brooklyn Academy of Music, to President Arthur and Governor Cleveland.

But these exercises, however interesting to the comparatively few who can witness them, will be as nothing compared to the great popular pageant, the sight of the millions of the two cities increased by the multitudes of strangers who will march over the bridge on the opening day.

PLACING THE STATUE OF LIBERTY.

Attention is called to the description and illustrations, published on another page, of the method proposed by Mr. John C. Goodridge, Jr., C.E., of New York city, to erect the Bartholdi statue of "Liberty Enlightening the World," and to build the pedestal upon which it is to stand. There is a reason for speaking first of the "erection of the statue," for that, by Mr. Goodridge's plan, will precede the construction of the pedestal.

Although no comprehensive or detailed plan has been accepted and published for the work of building the pedestal and raising the statue, it is generally supposed that it is to be done in the usual way of constructing the masonry—by means of false work, or staging, extending not merely to the top of the pedestal, 150 feet, but also to the top of the statue, and beyond, another 150 feet or more. At the best, this will be a very costly job, requiring much time and money, probably more than the cost of the entire statue.

Mr. Goodridge, however, proposes to dispense with the staging, and he proposes also to remove the apprehensions of those who fear the weakening and overthrow of the statue from the effects of the wind in its very exposed situation. It is claimed—and with good show of reason—that the statue, being composed of plates of comparatively light weight, and yet presenting a large surface to the wind, will be unable to sustain itself on its proportionally narrow base, and will require some internal support to give it the required rigidity. This is considered in Mr. Goodridge's plan; and he also proposes to make the use of the statue a present possibility instead of a future probability. He would erect and equip the statue at once with the electric light; and hereafter carry up the pedestal, the statue being lifted and taken up with the pedestal. The plan is simple, economical, and apparently very practical. This latter—the practical—is a quality for which the works of this engineer have always been especially distinguished.

THE DRIVE WELL PATENT.

In a recent trial in the United States Circuit Court, Des Moines, Iowa, the judge decides that the original drive well patent of N. W. Green is null and void. This decision might be important if it were not contrary to a number of other previous decisions by eminent judges of the United States courts, by whom the patent has heretofore been upheld. The present case will now go on appeal to the Supreme Court of the United States.

The invention of the drive well was made in 1861, by Nelson W. Green, an officer in one of the New York regiments then serving in the war. There was a rumor that the enemy had poisoned the wells. To make sure of a pure supply of water for his own regiment and for the Union forces generally, wherever they might march, he conceived the idea of driving into the earth small tubes of iron, perforated at the bottom, and of attaching a pump to the upper end of the tube. He reasoned that, when the pump was worked and suction produced, the water would rise in the tube, and thus serviceable wells might be made anywhere, by a few minutes' work, at small cost. His invention was found to be completely successful, was immediately adopted in the army, and our troops seldom lacked for good water wherever it was practical to drive down Colonel Green's tubes. From the army the use of the invention quickly spread through this country, then to foreign countries; it was adopted by the British army; it is now an adjunct of the military equipments of all nations, and is in common use throughout the world.

The patent to Col. Green was not issued to him until 1868, owing to the inability of the inventor to attend to the business of taking the patent until after his relations with the army were finally closed. Such, in brief, is the history of the drive well patent. It is one of the most useful inventions of the day, and has conferred vast benefits upon the people of this country and the world in general.

When Col. Green received his patent, he became entitled to demand compensation for the use of his invention from that time onward for seventeen years, and he established a general tariff or patent fee of ten dollars for each well made in accordance with his discovery. Many thousands of the Green drive wells were put into use before his patent was granted; for such prior use he could make no claim; but for the continued use of these wells after the grant of the patent, he was entitled to demand payment.

There are regions of country where every farmer has from one to ten of the Green wells on his premises; where, in fact, people have them in their kitchens, cellars, yards, and fields; wherever they want water, they drive a tube and put on the pump.

These people knew nothing about the patent when they put in the wells; and the appearance of the patentee's agents, asking for ten dollars' payment on each tube, with threat of a law suit if the demand is refused, naturally excites surprise and indignation. They feel as if their rights as American citizens were being invaded. What business, they ask, has the Patent Office to grant a patent to prevent us from pumping water out of the ground? We have always been accustomed to stick a tube with its pump into our cisterns and cellars to draw water; and we claim a free right to stick the tube into the ground and get water wherever we can. For reasons such as these many have refused payment; but the courts have decided adversely in various test cases, and the legality of the patent has been fully sustained.

But the costs of the law suits, and the expenses of collecting the royalties have greatly diminished the patentee's receipts. The patent will expire by its own limitations on January 14, 1885. If the Supreme Court should decide adversely to the patent in the present case, the inventor and his associates will probably lose more money than they have received from the invention. If the court sustains the patent, they may possibly realize a profit, as they will be enabled hereafter to collect damages from all who made use of the patent during its lifetime.

USES OF PAPER.

Under the generic term of paper, other substances used in combination with paper pulp are comprehended in general descriptions and occasional notices. When some wonderful story is read of the substitution of paper for wood, stone, the metals, for mortar, and plaster, and concrete, and other compositions, the reader should not understand that it is the material defined by Webster as "a substance formed into thin sheets or leaves, made of pulp obtained from rags, straw, bark, or like materials, pressed and dried." Paper, for so many and so differing uses as are attributed to it, must have something besides a vegetable pulp in its composition. In fact, the term "paper" is a misnomer for products that derive all their special qualities from foreign materials, held together by the paper pulp acting as a matrix. Thus, asbestos, in filaments, or powder, may be mixed with paper pulp to form a convenient uninflammable and possibly an incombustible material, shaped while plastic to convenience for special uses. So, clays in almost impalpable dust may become a part of the paper pulp production, and be a substitute for other materials. Other mineral substances may be mixed with the pulp, and, in short, there appears to be scarcely any limit to the uses that may be made of paper pulp mixed with foreign substances, moulded and pressed to form.

BELT WIDTHS.

An exchange says that "the true way to belt up machinery, and have it to do good service and last well, is to get a belt a little wider than your machine calls for; instead of getting a three-inch belt where you ought to get four, get five-inch instead, if you can possibly use it."

Indefinite advice of this character is of little value. Not only is it impracticable in most cases to substitute a five-inch belt for a four-inch, but in most cases, also, the builders of machinery have adapted the width of the pulley faces to the work the machine should be called upon to perform. Of course, no more work can be got out of a five-inch belt on a pulley with four-inch face than from a four-inch belt, and all the overplus in width is a weight and drag to be carried. There was a time, in the early history of manufacture in this country, when the home-made (shop-made) leather belts were run, at first, as wide as possible to allow for stretch and consequent narrowing. But belt-making is now an art, and the belts come from the factory fully stretched and of exact, unvarying width, a width that will

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be retained as long as the belt lasts. If the transmitting power of belts has not yet been formulated into unvarying and trustworthy rules, under all circumstances of diameters of pulleys, distances between pulleys, relative positions of pulleys—horizontal, vertical, or diagonal—enough is established to render unnecessary such a variation in the width of a belt for doing a certain amount of work as that of one inch in four.

How Cable Messages are Received.

Until the fore part of November the French cable, having its terminus at North Eastham, Mass., employed the flash system of signaling. Now the cable is worked duplex on the Sterns system, says the *Journal of the Telegraph*, using an automatic recorder, by which the messages are received in ink on a narrow strip of paper.

By the system which has been displaced the messages were spelled out by flashing a ray of light back and forth across a standard line, the right and left flashes corresponding with the dots and dashes of the ordinary telegraphic alphabet.

In this system the light is flashed by reflection from an extremely light mirror, which is turned to right and left by the opposing influences of positive and negative impulses. This system has the advantage of being operated with very slight electric impulses, but also the disadvantage of leaving no permanent record.

To secure the latter very important end the recording instrument has been adopted. The press dispatch announcing the change states that in the new recorder the ink is discharged by the agency of electricity and "not by capillary attraction as in other cable recorders." This statement is incorrect, electricity being now similarly employed in the recording instruments used at Heart's Content, the Newfoundland station of the Anglo-American Company's cables.

A recent visitor to Heart's Content describes as follows the method of receiving messages at that point. The recorder is a horseshoe magnet, electrified by the usual circles of fine wire, and attracting a small metallic coil. The coil is hung between the magnetic poles, and by a light lever and a thread almost as fine as the strand of a cobweb is connected with a delicate siphon hung in a little reservoir of ink. The ink is electrified, so as to produce a repulsion of the particles, making it flow more readily through the siphon, which outside is about the size of a darning needle, and the interior tube scarcely larger than a hair. The lower end of the siphon rests against a paper tape playing perpendicularly through rollers. The whole machine is almost of gossamer fineness and flexibility, so as to minimize the electric strain necessary for working the cable.

Let us imagine now that a coming message has been signaled from far across the ocean at Valentia. The operator at first opens the simple machinery that works the brass rollers. On the center of the tape, as it passes between the rollers, the siphon at first marks only a straight line. Suddenly the line swerves to the right or left. The message has started, and the end of the siphon has begun its record. Worked by two keys, and positively or negatively electrified, the coil swings the siphon point now to one side, now to the other, along the tape. Responsive to the trained hand of the operator, the filament of ink marks out one notch, two notches, three notches; then suddenly it may be a high elevation or depression, until the delicate line traced on the tape looks like the tiny outline of a mountain range.

But it is a range whose every hilltop, peak, and valley means an alphabetical symbol to the telegrapher's eye. The recorder is the invention of the famous electrician Sir William Thomson. How delicate an interpreter it is may be inferred from the fact that ten jars work 1,800 miles of cable between Valentia and Heart's Content, while twenty-five jars of the same electric power would be needed to work 350 miles of land wire; in other words, the recorder is more than twelve times as efficient for its purpose as the ordinary Morse instrument. The recorder traces its character on the tape about as fast as a slow penman copies a letter. Besides its delicacy of work, the recorder, as its name imports, has the merit of leaving the record of the message.

Telegraph or Telephone.

Despite the fact that recent experiments have demonstrated the possibility of telephoning over long circuits, it is to be doubted if the instrument will be used otherwise than locally. It is too sensitive to induction, to atmospheric electricity, and to grounds for circuits exceeding a few miles in length. The experiments have been tried under the best, not under the worst conditions, and through a complete metallic circuit—in other words, a double line. It is hardly possible for the telegraph business of two large cities to be conducted by telephone by the senders of messages themselves, for five hundred wires might not suffice to prevent a block in busy hours, and merchants could not and would not wait.

To operate telephones as the telegraph is now used would be equally impracticable. Even were the instruments as little liable to disorder as the Morse, the greater danger of errors would weigh against them. There is no system of signals as clear as the present Morse code as interpreted by the "sounder." Each letter of a word is given, and ordinarily good operators seldom err in the record. By telephone it is the sound of a word, and not its vowels and consonants, which the operator receives, and a mistake can easily happen even under the best conditions. It is to be doubted, too, if the rapidity of transmission by telephone, where the message had to be written down at the receiving station, would even approximate that of the Morse system. Proper names, scientific terms, and phrases in a foreign language, etc., would have to be carefully spelled out, and even then would fall wide of accuracy.

By the Morse system good operators will receive at the rate of forty-five words a minute, which is almost the limit of rapid penmanship, and will often take a 2,000 word message without once interrupting the sender. The lines, too, will work in the heaviest weather, and are only interfered with by serious electrical storms, or by actual accident to the wires. Again, by the quadruplex system, four messages can go at once over one wire, while the long distance telephone requires two wires for one message. All in all, there seems to be but little prospect of the present series of experiments resulting in a practical good, however gratifying from a scientific standpoint.—*N. Y. Sun.*

New and Remarkable Chemical Experiments.

The liquefaction of oxygen gas and nitrogen, the freezing of alcohol and sulphide of carbon, are the latest achievements of chemical science. This news comes to us from the laboratory of M. Wroblewski, in Cracow, Poland, who has given some interesting particulars in a dispatch to M. Debray, published lately in *Comptes Rendus*. By the use of liquefied ethylene, M. Wroblewski and K. Olszewski obtained the remarkably low temperature of —136° C., equal to —212·8° F. Oxygen gas subjected to about this temperature, and compressed under a pressure of about 25 atmospheres or 375 pounds to the square inch, was readily liquefied in glass tubes, and formed a colorless and transparent liquid, very mobile, and resembling carbonic acid.

Nitrogen was also liquefied, forming a colorless liquid.

Alcohol was solidified at —130·5 C. or —202 9° F., forming a white body. Sulphide of carbon froze at about —116° C. or —176·8° F.

These are certainly very interesting and remarkable experiments. Air contains by weight, approximately, 23 parts of oxygen and 77 parts nitrogen. It is common to compress it to a far greater degree than above mentioned. For motive power, in driving compressed air locomotives, a compression of the air to 1,000 pounds to the square inch is in some cases employed. The difficulty heretofore experienced in the liquefaction of oxygen and nitrogen has been to obtain a sufficiently low temperature in conjunction with compression. This obstacle now appears to be removed, and a variety of new and valuable observations concerning the nature of gaseous substances may be expected.

Artistic Type.

It must be confessed that while a modern press can turn out a vast number of volumes with great credit, scarce any book nowadays can vie in beauty with the old Alding books, with many printed in Italy in the seventeenth and eighteenth centuries, or with those printed by our English Baskerville in the last century, between the years 1756 and 1775. One reason of this is that our types are not so beautiful. In old days each type founder was desirous of getting designs for his letters from men of real artistic feeling; nor did these disdain to design a comma, any more than they would scorn to make a beautiful leaf or flower in a picture devoted to saints or historical personages. There is a tradition that Hogarth designed Baskerville's types, which is likely enough; at any rate, they were the last English types of originality or beauty.

The best now existing are copies of copies, reproduced mechanically, which have long ceased to have the human brain infused, as it were, into the molten metal. The best existing types at this moment are French, and they, not ours, are the true descendants of Baskerville's; for at his death in 1775 his types were sold to France, and used to print an edition of Voltaire, still well known, and most excellent in its workmanship. The modern French types of the best fonts are reproduced, as it would seem, from these, but with less of exact mechanical copying and more of human variation and fancy. There could scarcely be a better work for the artistic future of books than that which might be done by some master of decorative art, like Mr. William Morris, and some great firm of type founders in conjunction, would they design and produce some new types for our choicer printed books.—*Fortnightly Review.*

A Fishway for the Potomac River.

For the Potomac at Great Falls, in order to facilitate the movements of shad, an appropriation of $50,000 has been made by Congress, and the United States Fish Commissioner, Professor Spencer F. Baird, invites suggestions as to the construction of a proper fishway. There are certain engineering difficulties which would have to be overcome, due to the rocky nature of the bed of the river and ice accumulations in winter. Maps of the river can be had of Professor Baird, necessary for a thorough acquaintance with the contour and grade found at the falls.

THE New York Belting and Packing Company, probably the most extensive manufacturers of rubber belting, packing, and hose in the United States, have just removed to their new building, No. 13 Park Row, New York. The new quarters of the company have been fitted up with special design for the business, and are most complete in every respect. They are located directly opposite the Post Office and Astor House.

Sunday in New York City.

A recent number of the New York *Tribune* contains an interesting article, showing how Sunday is passed in the great city of New York, with its population now numbering a million and a quarter of people.

The church membership is given at nearly one half the population, or 600,000 members, of which 500,000 are by estimate credited to the Roman Catholics, but of this there is no actual enrollment; there are 100,000 enrolled members among the Protestant churches. The Catholics have 190 churches, the Protestants, 310, total 500 churches. The Protestants have 365 Sunday schools, and 119,000 scholars attend. Catholic Sunday schools not given.

As to Sunday amusements in summer, about 75,000 persons leave the city for excursions into the country and the sea shores. The Germans, of whom there are about 250,000 in the city, visit the beer gardens in large numbers. Central Park receives 100,000 visitors on Sunday. Only one or two libraries are open on this day, at which the attendance is about 2,000. As for drunkenness and other crimes, there is a trifling let up on Sunday; the average number of daily arrests is 193; the average for Sunday is 182. Monday, 227. On Sunday evenings there are a few concert halls and beer song places open, visited, in the aggregate, by about ten thousand persons.

Twenty-four o'Clock.

The *Railway Reporter* says that the Cleveland, Akron, and Columbus Railroad Company have recently issued a new time card, based on the twenty-four hours system—that of numbering the hours of the day from one to twenty-four, instead of making two divisions of twelve hours each designated or distinguished as Ante Meridian and Post Meridian—A. M. and P. M. At present still another designation is used, that of M. when 12 midday is to be distinguished from 12 P. M. The *Reporter* says that this company is the first to employ this continuous system; but in reality the method is a very old one, coeval with the history of clocks, and is still in use in some parts of southeastern Europe. The *Reporter* adds, that "the day begins at midnight, as under the common system, but there is no possibility of confusion between forenoon and afternoon hours. The great advantage of this scheme in a railroad time table will be seen at once: 7 A. M. and 7 P. M. are frequently misprinted or misunderstood, while no one will confound 7 o'clock with 19 o'clock. Any watch or clock can be adapted to the system by simply putting the extension of the hours in a circle just inside of those already on the face. The exterior numbers will then be consulted up to 12 o'clock (noon), and the interior ones for the remainder of the day.

Fuchsias.

Fuchsias like a rich soil, freely drained, consisting of turfy loam, old, thoroughly decayed manure, or leaf-mould in about equal portions, with a good sprinkling of charcoal dust and sand, and, if at hand, a handful of bone-meal may be added at the last shift. Should they be required to bloom for a long time and continuously, they must be well fed. They are often well grown under vines, the moist atmosphere necessary for their proper development and the partial shade of the vine foliage seeming to benefit them materially; bear in mind, however, that where the vines are closely trained and the foliage becomes dense, the shade will be too much for the fuchsias.

New Postage Rates.

On and after October 1, 1883, letter postage will be uniform at two cents for letters to any part of the United States. On and after July 1, 1883, money orders for $5 and under may be obtained for three cents. The order will be payable to bearer, and will be good for three months from date of issue; after that time the holder can get par value only by applying to the department at Washington. On the same date the rate of money orders on all sums will be changed, and not exceeding $10 be procurable for eight cents, and from that to $100, the rate increasing up to 45 cents.

LUMINOSITY OF THE MAGNETIC FIELD.—Professor W. F. Barrett, of Dublin, has been making some interesting experiments to test the correctness of the discovery claimed to have been made by the late Baron von Reichenbach, viz., that a peculiar luminous effect, resembling a faint electric discharge in rarefied air, emanated from the poles of a magnet, and was rendered visible in a perfectly darkened room. These new experiments confirm those of Reichenbach.

W. E. SAWYER the well known electrical inventor and writer, died at his residence in Waverley Place, in this city, on the 15th instant. Professor Sawyer's name is familiar to our readers, as it has on several occasions been presented in our columns in connection with his inventions. He was a tireless worker in the field of electric illumination, and devised many novel things in that line.

NEW subscribers to the SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT, who may desire to have complete volumes, can have the back numbers of either paper sent to them to the commencement of the year. Bound volumes of the SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT for 1882, may be had at this office, or obtained through news agents.

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GOODRIDGE'S PLAN FOR THE ERECTION OF BARTHOLDI'S STATUE.

The question of the most desirable plan for the erection of the Bartholdi Statue of Liberty in New York Harbor is one of considerable interest to engineers, and those who are in the habit of working on engineering structures. In size the

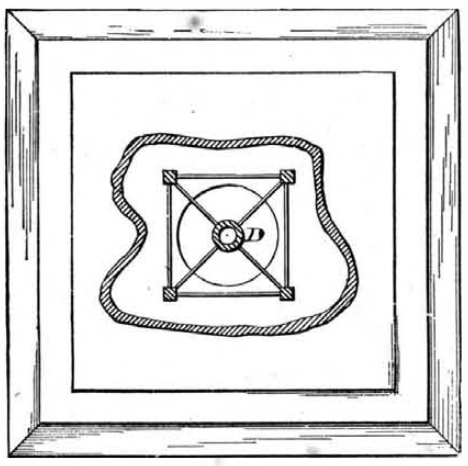

Fig. 3.—PLAN OF BRACING AND TUBE.

statue and its pedestal are beyond precedent, and as the statue is not only to be erected but maintained in position, its enormous height together with its light weight render the problem somewhat difficult. The statue is formed of rolled copper riveted together. It measures 150 feet in height, and weighs less than eighty-six tons, and is to be placed upon a pedestal about 148 feet in height. This construction renders it assailable by the strong winds that sweep our bay.

One of the plans proposed for this work, and one which

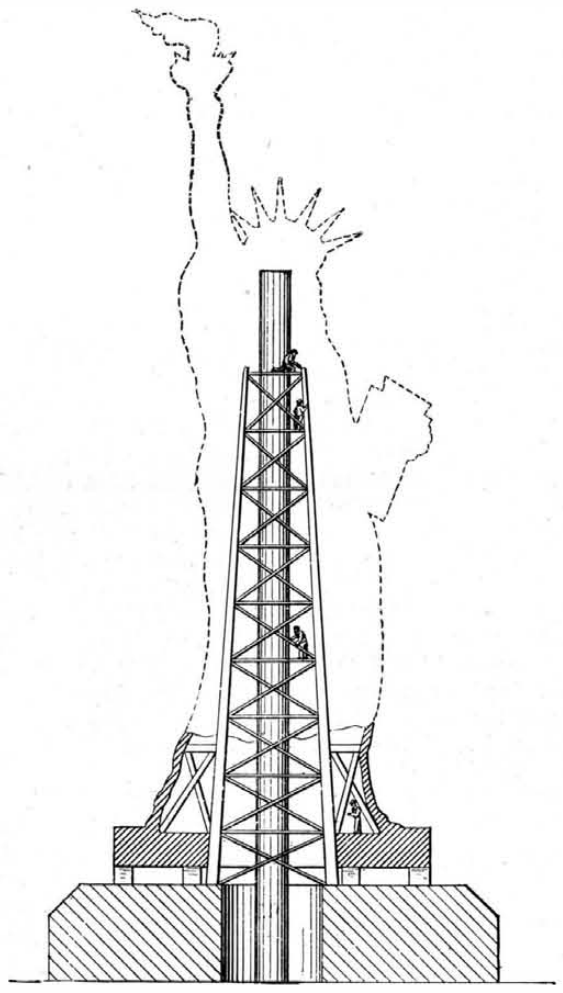

Fig. 2.—INTERIOR BRACING AND FRAME.

has been made the subject of an application for a patent by John C. Goodridge, Jr , of this city, is illustrated by our engravings and may be thus briefly described.

The foundations having been built, a series of piers are built upon it. These piers are incorporated into the structure as the work progresses, and on them the base of the statue is placed, and the statue is assembled. As the several parts of the statue are put together by devices which it is not necessary for us now to describe. It is lined with concrete or similar materials of fine

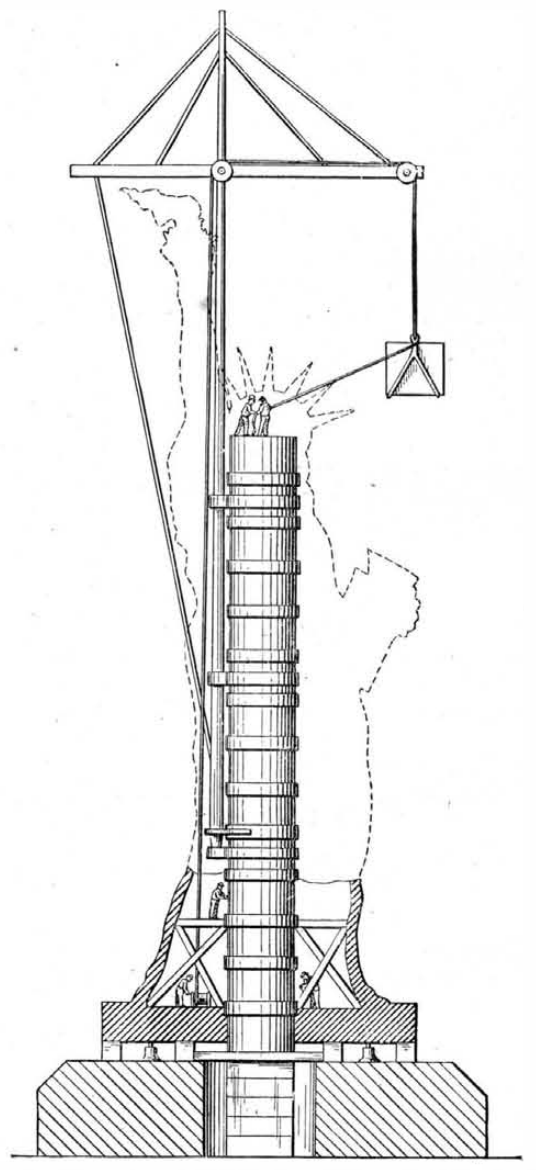

Fig. 1.—MODE OF SETTING UP THE STATUE, CRANE, INTERIOR TUBE, AND BRACING.

quality, making it heavy at the base, and decreasing in thickness as it goes up. The intention of this is to give the statue greater weight and increase its strength and stability.

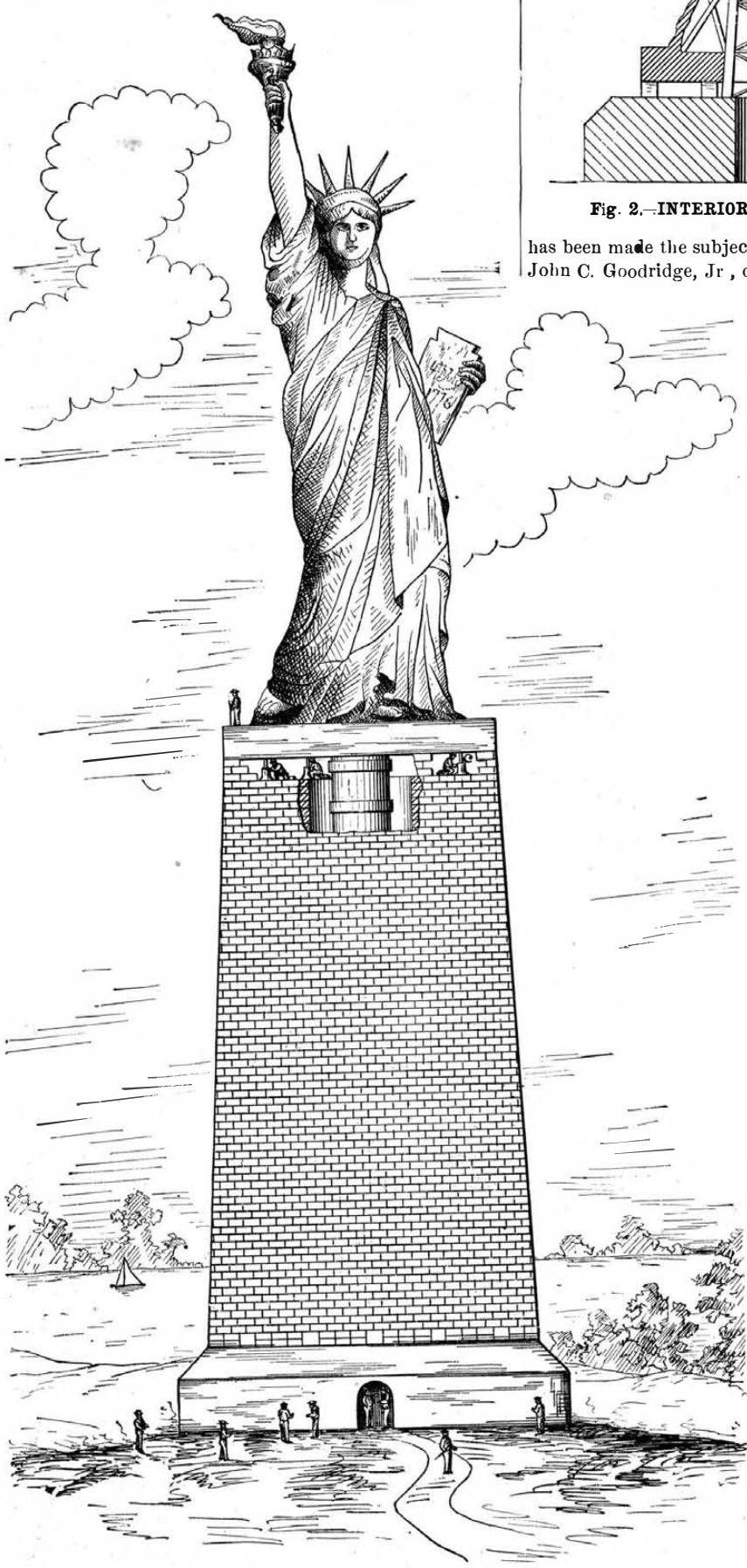

Fig. 5.—THE STATUE AND PEDESTAL NEARLY COMPLETE.

Fig. 4.—THE STATUE SET UP COMPLETE AND READY FOR ELEVATION.

GOODRIDGE'S PLAN FOR THE ERECTION OF THE STATUE OF LIBERTY AND ITS PEDESTAL IN NEW YORK HARBOR.

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When the statue is completed, a series of jacks (or mechanism of a similar character) are placed upon the foundation between the piers upon which the statue now rests. By working these jacks the statue is lifted bodily high enough for a course of masonry to be built upon the piers; the spaces between the piers are then filled as high as the statue has been lifted, the jacks replaced, and the process continued until the statue reaches the required height.

If desirable the erection of the statue, and the building of the foundation, may be proceeded with simultaneously.

In addition to this, if desirable, a number of tubes are carried through the well hole or other apertures left in the masonry, so that large jacks remaining stationary on the foundation can be made to lift the statue, the tubes to be increased in length at the bottom as the work progresses.

Iron rods, passing up through the masonry and through the pedestal, are so arranged as to gauge the height to which the statue shall be raised at each lift, and to keep it permanently fastened to the pedestal. These tubes or columns are attached, and form a part of the interior bracing of the statue.

When the statue has reached its proper height, these columns can be cut off from the bottom, leaving them suspended from the base of the statue and its interior bracing, thereby adding to its weight and lowering its center of gravity.

In the engraving Fig. 4 shows the statue assembled on its foundation ready to be lifted. Fig. 5 shows the statue during the process of erection. Fig. 1, Fig. 2, and Fig. 3 will give an idea of the details of this plan to any one familiar with this class of work. The engravings are intended to give simply an idea of the construction and not the architectural design.

The statue will be safe at all times during the progress of work, and may be left without danger during the seasons in which it is not practicable to carry on such work. There is another advantage, and one which is of importance to the public generally—that is, the statue by this method can be put up as soon as the foundation is prepared, and by the same men who are now putting it together.

The difficulty of putting the statue together, some time hence, by those not familiar with its construction, is apparent. As the money is to be collected by subscription, some time may elapse before it is all received; and by other methods of erecting the statue it could not be put in position until the pedestal is completed, while by this method the statue can be erected at once with the funds now available, and commence its mission of lighting the world, or at least that portion of it visible from Bedloe's Island.

DE LABASTIDE'S POCKET MITRAILLEUSE.

The "pocket mitrailleuse" constructed by Mr. De Labastide, of Nice, is a weapon which, though of small size, carries many cartridges; for the dimensions of an apparatus carrying 12 cartridges and of 7 millimeters caliber need not exceed 6 centimeters in width, 10 in length, and 2½ in thickness. The weapon partakes of the form of a small bound book, and occupies no more space than a cigarette case. The absence of a butt and other projecting parts, which are so much in the way in ordinary pocket weapons, renders this terrible apparatus essentially portable, as well as convenient to handle.

The annexed figures represent a six-shooter type which has served in experiments; but, as the number of cartridges carried in no wise modifies the system, the figures will answer to allow of a description being understood. Fig. 1 gives a general view of the mitrailleuse, which is a sort of oblong case, open at the top and bottom, of slight depth, and into which slide like a drawer the ten barrels (Fig. 2) that are hidden in Fig. 1 by a morocco cover. To one of the extremities of this case there is affixed a piece of wood forming a pommel. Above is seen the hammer. At the lower part of the other extremity there is a circular aperture, and, at the upper part, a projecting channel through which the balls pass freely. The piece interposed between these two parts is the trigger.

To use the weapon, it is held in the hand with the wooden part resting in the palm, while the middle finger is passed through the circular aperture. In this position the apparatus is held very firmly and the forefinger is left free to manipulate the trigger. The hammer, PP (Fig. 3), which occupies the whole length of the apparatus, slides in a groove on one side of the case, and its striking part is bent at right angles and forms a head which carries two points (Fig. 6). It is pulled into the position shown by the dotted lines, PP', by a large spring, G R (Fig. 3). In this position the points will have traversed two holes in the breech, and one of them will have struck the center of a cartridge, while the other will have entered a small hollow, *c*, between two of the barrels (Fig. 7). The barrels (same figure) are arranged quincuncially, so that, after each ascent brought about by the motion of the hammer, they will present themselves successively before the points in the order numbered in the figure, and that when the point to the right falls on a cartridge to the right, the point to the left will drop into the hollow opposite it. The opposite effect is produced when the point to the left strikes the cartridge to the left. A series of small pins, the same in number as the barrels, is arranged on each side of the latter, and serves as a rack for raising them bodily to a distance equivalent to the distance apart of two of the pins, at each recoil of the hammer.

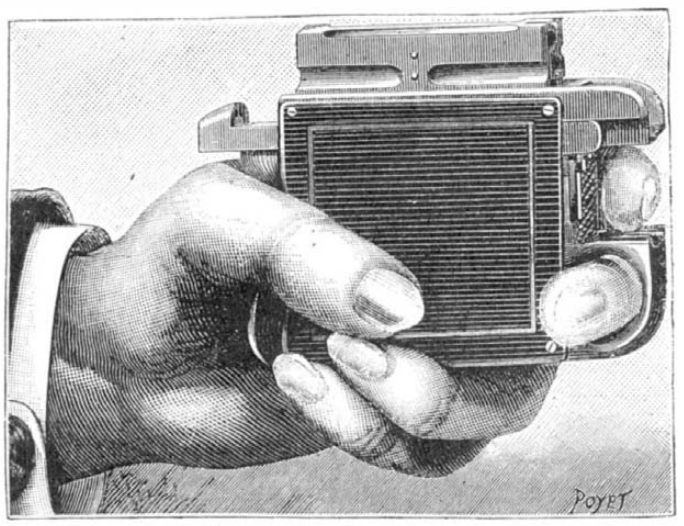


Fig. 10.—MANNER OF USING THE POCKET MITRAILLEUSE.

In the center of the hammer rod there is a notch (Fig. 3), in which is placed a triangular piece, *t*, which is movable around the screw which holds it, and which a small spring, *r*, tends to keep in the position shown by the dotted line, *t'*. On examining the figure it will be readily seen that, when the hammer is drawn back, this little piece, by passing under one of the pins of the rack, will cause the system of barrels to rise until the pin has lifted the small spring, *r*, which latter will at once fall back behind it so as to prevent the barrels from dropping again. In this position the hammer will be enabled to return to its first position without moving the combination of barrels, these being held, as they are, by the pin remaining over the little spring.

The mechanical part of the hammer just described faces the interior of the case, and is shown externally in the figure only, so that it may be more readily understood. The combination of barrels is provided with two racks, and operates just as well with one as with the other. If, after firing only a few shots, it be desired to put the weapon in the pocket, the barrels are withdrawn the rest of the way from their sheath by a backward and forward motion of the hammer, and are then reversed and put back into the case, so that the cartridges that were at the bottom are now at the top.

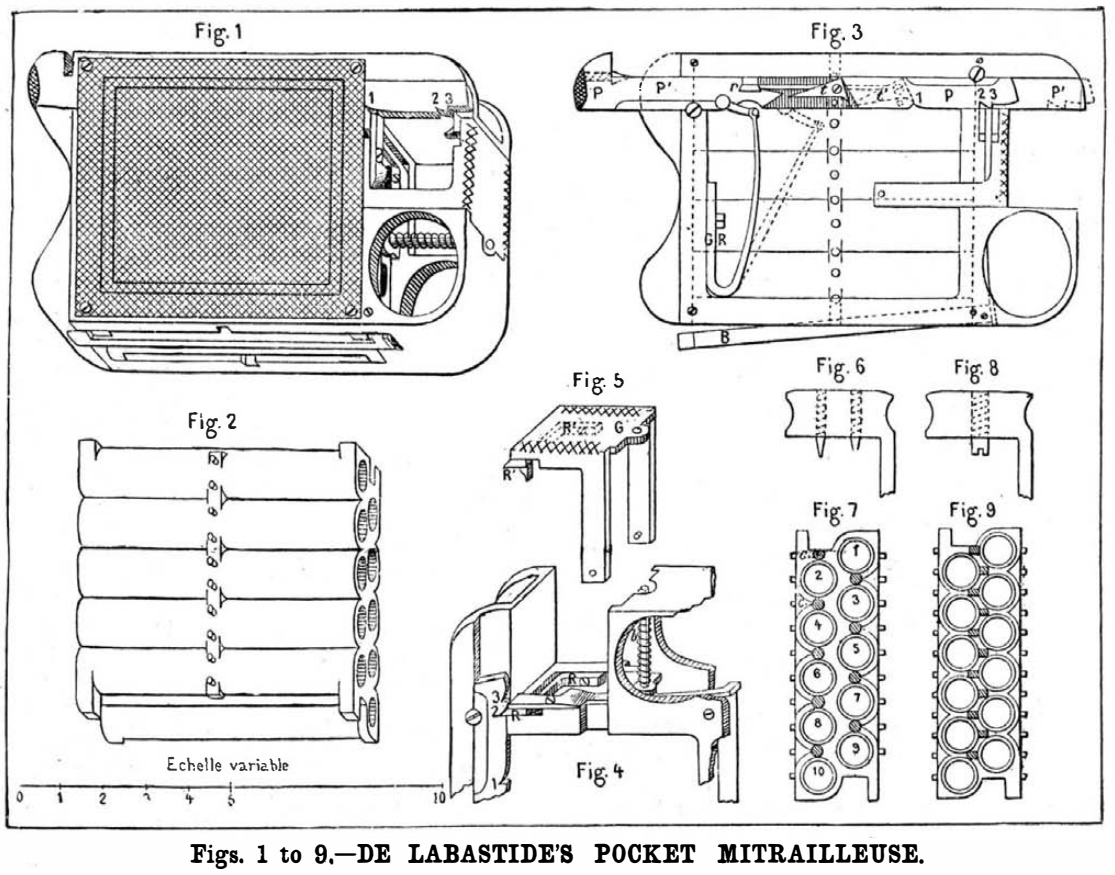
A spring, R (Fig. 4), abuts against the hammer rod, and when this latter is pushed back, introduces itself into the first notch, 1, which is the safety catch (Fig. 1), and afterward fastens the central notch, 2, which is the catch of the weapon (Fig. 4). Under these two circumstances the hammer will be held very firmly, although the spring, G R, tends the while to pull it back.

To the trigger, G (Fig. 5), there is fixed another spring, R', very nearly like the former, but provided with a tail piece whose point, when the trigger is pushed in, passes between the spring, R, and a projection under the trigger guard, and abuts against the latter, until the two springs, R R', leave their catch (Fig. 3). Then the large spring acts with all its power, and percussion is effected. The firing having taken place, a spiral spring, *b*, draws back the trigger as seen in Fig. 1. If the trigger acts directly upon the hammer, its spring catches in the last notch, 3, carries it along, and, reaching the end of its travel, frees itself therefrom, as has just been said.

In the lower part of the apparatus there is a rod, B (Fig. 3), which is designed for disengaging the barrels.

If it be desired to use rim fire cartridges instead of central fire ones, a hammer which is made in a single piece must be employed. In such a case it will be possible to place the barrels much nearer each other, since there will be no longer any need of leaving vacant spaces between them to receive the points.

As may be seen, this weapon operates like the most improved revolvers. It may be fired either by drawing back the hammer by means of its head, or by pressing with the forefinger on the trigger.—*La Nature.*



Figs. 1 to 9.—DE LABASTIDE'S POCKET MITRAILLEUSE.

Underground and Submarine Wires.

Our London contemporary *Nature* has an article on the above subject in which it says wires are almost invariably carried underground through towns. Copper wire insulated with gutta-percha, incased in iron pipes, is the material used. There are 12,000 miles of underground wire in the United Kingdom. There is a great outcry for more underground work in England, owing to the destruction to open lines by gales and snowstorms; but underground telegraphs, wire for wire, cost at present about four times as much as overground lines, and their capacity for the conveyance of messages is only one-fourth; so that overground are, commercially, sixteen times better than underground wires. To lay the whole of the Post Office system undergound would mean an expenditure of about £20,000,000. Hence there is no desire to put wires under ground except in towns. Besides, snowstorms are few and far between, and their effects are much exaggerated. Of the numerous materials and compounds that have been used for insulating purposes, gutta-percha remains the oldest and the best for underground purposes. It, like all other materials used for telegraphy, has been improved vastly through the searching power that the current gives the engineer.

The past ten years have seen the globe covered with a network of cables. Submarine telegraphs have become a solid property. They are laid with facility and recovered with certainty, even in the deepest oceans. Thanks to such expeditions as that of H. M. S. Challenger, the floor of the ocean is becoming more familiar than the surface of many continents. There at present 80,000 miles of cable at work, and £30,000,000 have been embarked in their establishment. A fleet of twenty nine ships is employed in laying, watching, and repairing the cables. The Atlantic is spanned by nine cables in working order. The type of cable used has been but very little varied from that first made and laid between Dover and Calais; but the character of the materials, the quality of the copper and the gutta-percha, the breaking strain of the homogeneous iron wire, which has reached ninety tons to the square inch, and the machinery for laying have received such great advances that the last cable laid across the Atlantic, by the Telegraph Construction and Maintenance Company, was done in twelve days without a hitch or stoppage.

THE *Journal de Pharmacie* says that a mucilage composed as follows will unite wood, porcelain, or glass: eight and a half ounces of gum arabic in strong solution, twenty grains of solution of alumina dissolved in two-thirds of an ounce of water.

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THE NEW YORK AND BROOKLYN BRIDGE.

The practical completion of the grandest piece of bridge engineering the world has yet seen necessarily attracts attention, not only in the immediate vicinity of the work, but throughout the civilized world; not only from curious sight seers, but from those who labor for the advancement of their fellows and rejoice in the success of a stupendous undertaking. In many respects this bridge has been an innovation, not only because of its vast proportions, but because of the materials entering into its construction. From time to time during the past thirteen years we have described and illustrated the main parts of the bridge at the time of their being finished, yet we do not think it amiss at the present time to summarize as briefly as possible the dominant features of this triumph of the science of engineering.

On the 16th of April, 1867, the Legislature of New York passed an act incorporating the New York Bridge Company, for the purpose of building a bridge over the East River between the cities of New York and Brooklyn. On the 23d of the following May, John A. Roebling was appointed chief engineer, and toward the close of the same year made his report, discussing at some length the three routes and the practicability of building suspended bridges of long span. The charter fixed the Brooklyn terminus at the junction of Main and Fulton Streets, but allowed the New York terminus to be at or below Chatham Square, but not south of the junction of Chatham and Nassau Streets. Considering the value of the property to be condemned, the grades, the difference in the cost, and the fact that City Hall Park would remain the center of travel for many years, it was thought best to build on the Park line. During the summer of 1869, a detailed survey of the route was made, and the Brooklyn tower located. It was while engaged in this work that Mr. Roebling met with a most serious accident. His right foot was crushed by the shock of a ferry boat against the fender rack of spring piles on which he was standing. Lockjaw set in, and after sixteen days of extreme suffering terminated in his death. In August of the same year his son Washington A. Roebling was appointed chief engineer.

The plan of the bridge was approved by the Secretary of War, and under date of June 21, 1869, the Chief of Engineers wrote to the company stating that under no conditions must the center of the span be less than 135 feet above mean high water; no portion of the tower foundations above the river bed must project beyond the pier lines; and no guys must ever be attached to the main span which will be below the bottom chords of the bridge.

An act was passed June 5, 1874, changing the name to that of the New York and Brooklyn Bridge, and making it a public work to be constructed by the two cities, Brooklyn paying two-thirds of the cost and New York one-third.

Taken as a whole the bridge consists of the approaches, one at each terminus; station buildings at the extreme ends; an anchorage, at the end of each approach, to which the four cables are fastened; two towers, over which the cables pass. To the cables are secured ropes on which hang six systems of longitudinal trusses, connected transversely by floor beams, dividing the width of the bridge into two roadways, two carways, and one promenade.

Work was commenced on the foundation of the Brooklyn tower on January 3, 1870. Borings, made previously, showed gneiss rock at a depth of 96 feet below high water, above which were layers of hardpan and trap bowlders embedded in clay and sand. This was considered compact enough to form a satisfactory foundation without going more than 45 or 50 feet below the surface of the water. Timber immersed in salt water is, practically, imperishable, and if placed below the bottom of the river will be out of reach of sea worms. It was therefore decided, in order to secure a bed of uniform character, to build a solid timber foundation having strength sufficient to act as a beam, and weight to insure even settling. The magnitude and importance of this feature in the great work becomes apparent when it is known that it would be called upon to sustain a dead weight of some eighty thousand tons.

The caisson was an immense box having a roof and sides but no bottom, so that when it was placed over the site and sunk, the water would not rise in the interior beyond the edges, thus forming an air chamber in which the men were free to work. The caisson was 102 feet wide, 168 feet long, the height of the air chamber being 9½ feet. A section through the sides formed a V, the inner slope of which had an angle of 45 degrees, and the outside of all the walls had a batter of 1 in 10. The walls sloped down to an edge, or shoe, formed by a semicircular casting, protected by boiler plate extending 3 feet up the sides. The timbers forming the V were held together by drift and screw bolts, and secured to the roof by angle irons and common timbers. The roof, upon which the tower was to rest, consisted of fifteen courses of Georgia pine timbers 12 inches square, alternate courses being laid in the same direction, and the pieces bolted both horizontally and vertically. To make the caisson air tight the seams were thoroughly calked, and in addition a vast sheet of tin was inserted between the fourth and fifth courses and down the four sides. There were shafts cut through the roof of the caisson for the passage of the laborers and to take out the excavated material and admit supplies. There were two water shafts made of boiler plate three-eighths of an inch thick, and having a rectangular section 7 feet by 6½ feet. These shafts were open both above and below, and the lower end extended below the edge of the shoe for 21 inches. Through these shafts descended dredges which grappled and raised any substance placed beneath the opening. There were two air shafts, 3½ feet in diameter, having an air-lock at each upper end, for the use of the men. The supply shafts were cylindrical, 21 inches in diameter and furnished with two doors, one above and one below. To admit material the lower door was closed, and the tube filled with the desired objects, after which the upper door was closed. The valve to the equalizing pipe was then opened, and as soon as the air pressure in the tube was equal to that in the chamber the lower door was opened, when the material fell into the chamber. All the doors to the air locks, as well as those to the shafts, fitted closely and swung into the chamber having the greater air pressure. Five massive frames, or walls, divided the air chamber of the caisson into six compartments. When this great box had been finished, it was launched and towed to its future resting place.

During the building of the caisson the site of the foundation had been cleared, and a rectangular space a little larger than the caisson, and having a depth of water sufficient to float it, had been prepared. On May 1, 1870, the caisson was towed down, and on the following day was warped into position. The tower proper was now commenced on the top of this caisson, but it was not until three courses of masonry had been laid that the caisson was weighted sufficiently to rest firmly on the bottom and resist the action of the tides. Six air compressors had been placed on the surface for the purpose of supplying air to the air chamber of the caisson. The pressure in this chamber was kept equal to the hydrostatic head, differences in the materials passed through making slight deviations from this rule necessary. The work of excavating was carried on from the chamber, all obstructions being removed from under the shoes and frames. At the same time the masonry was being laid on top with the aid of boom derricks and engines. When bowlders were encountered too large for easy handling, they were pulled out of the way by hydraulic jacks, then drilled and blasted. The blast produced no ill effects on the men, although some trouble was anticipated owing to the dense atmosphere.

Gradually but surely the caisson sank toward its final resting place, while the tower grew above it. At the end of five months 20,000 yards of earth had been removed. As the caisson proceeded downward the disproportion between the load above and the buoyancy became more and more, and to support this overweight additional shores were introduced, which rested upon a block and wedges and supported a cap placed against the roof. When the caisson had reached within three feet of its journey's end, 72 brick piers were built having bases averaging 20 square feet. These had strength enough to uphold the whole mass if the air pressure should from any cause be removed. When the caisson had reached a depth of 44½ feet below mean high tide, the operation of filling the entire air chamber with concrete was begun. The concrete consisted of one part of Rosendale cement, two of sand, and three of small sized gravel. The total quantity required, including the brick piers, was about 4,000 yards.

The danger from fire in an atmosphere of compressed air is very great, and the difficulty of quickly subduing it makes every known precaution necessary. At a pressure of 25 pounds to the square inch, the flame of a candle will return after having been blown out. On December 2, a fire was discovered in the caisson after it had been going some hours and attained considerable headway. Streams of water, steam, and carbonic acid were successively tried, but availed nothing. After struggling unsuccessfully for some time the caisson was flooded, and left so for two and a half days.

When the air was again admitted and the water expelled, about 200 borings were made in the roof to ascertain the extent of the fire. Vertically it was confined to the third, fourth, and fifth courses of timber, but laterally it extended to points 50 feet apart. Holes were made in the roof, the charcoal scraped from every burned stick, and the holes filled with cement. In order to prevent any settling at this point, a pier of square blocks of trap rock was built directly under the space burned. Cleaning and filling the burned section occupied 18 carpenters, working day and night, two months, besides common labor.

The Brooklyn caisson, completed, contained 250 tons of iron and 111,000 cubic feet of timber.

The New York tower is located in a direct line from the Brooklyn one, perpendicular to the stream, and at a distance of 1,595½ feet. Borings on the site did not encounter rock before reaching a depth of from 77 to 92 feet below high water, and as extensive beds of quicksand rested on the rock, it was necessary to go to it for a firm foundation. As this caisson would ultimately be subjected to a much greater pressure than the one upon the other side, the dimensions were made 102 by 172 feet. The roof was 22 feet thick, surmounted by a coffer dam reaching to high water mark, thus increasing the buoyancy, and lessening the pressure on the frames during sinking. The air chamber was 9½ feet high, and divided into six compartments. The interior of the chamber was lined with boiler iron, riveted together and calked. This lining made the chamber airtight and guarded against fire. Twe sets of double air locks were built into the roof of the caisson, each being 6½ feet in diameter by 8 feet in height. There were four supply shafts, two of which were 24 inches in diameter and two 21 inches. The caisson was sunk to a depth of 78 feet in a manner very similar to that pursued on the other side, but owing to the nature of the material passed through, sand pumps were introduced, which utilized the air pressure in the chamber to force the sand out through tubes. The air chamber was filled as in the other case, except that the brick piers were deemed superfluous owing to the greater strength. The New York caisson contained 180 tons of bolts, 200 tons of iron work, and 118,000 cubic feet of timber.

The tower is not a solid mass of masonry, but consists of three buttressed shafts, joined together up to the roadway by four connecting walls. In the Brooklyn tower the course next the caisson is 17 feet thick; the thickness diminishes by offsets until at high water it is but 10½ feet. This forms two well holes, which are filled with concrete below water line, but left open up to the roadway. Spaces were also left from 2 feet above the arches to within 4½ feet of the top of the tower.

In one of the wide shafts is a small vertical opening 2 feet 5 inches by 3 feet, connecting with one of these small spaces. By means of a trap and iron ladder access can always be had to the roof. Above the roadway the tower consists of three columns having an oblong section, and united at the top by arches having a span of 39¾ inches. The points of the arches are 114⅓ feet above the roadway. The arches are pointed and are formed by the intersection of two arcs of circles having a radius of 48⅓ feet.

In order to guard against any possible change of form, heavy irons were inserted in the masonry and rods placed across the span. The masonry of the towers below water is largely limestone, except the facing of the two upper courses, which is granite. The backing above high water to the roadway is mostly granite, and all the remainder of the work is granite. To raise the stones from the yard at the foot of the tower to the work, engines driving drums were used. About the drums was wound a rope which passed over a pulley on the top of the completed course of the tower. A lewis having been put in the stone to be raised, it was attached to the rope and hoisted to the top. Here a car running on rails projecting over the edge was run under, and the stone lowered on it. Having reached the tower, the derricks carried it to its destination. Upon the upper portion of the work balance derricks were used instead of the boom derricks.

The vertical dimensions of the towers are as follows:

Height of roadway above mean high tide, 119¼ feet; height of springing of arches above high tide, 198 feet; height of springing of arches above roadway, 79¼ feet; height of ridge of roof stone, 271½ feet. The height of the ridge of roof stone of the Brooklyn tower above bottom of foundation is 316 feet. In the New York tower the height of ridge of roof is 349½ feet. A balustrade around the towers will increase the height to 276 feet above tide.

The following are some of the horizontal measurements: At the top of the caisson the Brooklyn tower is 151 by 49 feet, and the New York tower is 157 by 77 feet; at high water the Brooklyn tower is 57 by 141 feet, and the other 59 by 141 feet. At these points the towers have a solid section. At the base of the three shafts, or roadway, the Brooklyn tower is 45 by 131 feet; at the springing of the arches, 42½ by 128½ feet; at the base of the upper cornice it is 40 by 126 feet. The openings in the towers are 33¾ feet wide. Above high water the New York tower differs from the other by an increase of 3 feet in thickness in the direction of the axis of the bridge. The total weight of the Brooklyn tower, masonry and timber, is 93,079 tons. The greatest pressure at any point in the tower masonry will be at the base of the central shaft above roadway; this will be about 26 tons to the square foot, or 361 pounds per square inch.

At a distance of 930 feet from each tower is an anchorage designed merely to resist the pull of the cables which pass over the towers. These rest on timber foundations, the spaces between the sticks being filled with concrete. The masonry of the Brooklyn anchorage is 4 feet above tide, while the other is at high tide level. The Brooklyn foundation is 119⅓ by 132 feet; New York foundation, 119⅓ by 138 feet. The masonry is similar. The work is solid with the exception of two openings, or tunnels, in the river side, which are arched by semicircular arches of 23 feet span, springing at from 62 to 66 feet above tide. The anchorages are about 90 feet high above tide level. They are built of limestone and granite. The Brooklyn anchorage contains 27,113 cubic yards of masonry; the New York, 28,803 cubic yards.

In the end of each anchorage furthest from the towers are four anchor-plates (one for each end of each cable), which are held down by the dead weight of masonry piled upon them, and to which the cables are attached. The anchor-plates in the Brooklyn anchorage are placed 8 feet above tide, and those in New York 6 feet. These plates are cast-iron, 2½ feet thick at the center, and measure 16½ by 17½ feet on the surface. In form they much resemble an enormous wheel, having a massive hub and 16 spokes but no rim. Each plate weighs about 23 tons. The cables enter the corner of the anchorage diagonally opposite the plates, and after traversing a short distance horizontally, make a curve of about 90 degrees to the plates. The wires composing the cable do not come much beyond the corner of the tower, the connection between them and the plates being made by anchor bars. These bars start in double sets from each plate, one curving over the other, and are vertical for a distance of about 25 feet, when they curve about 90 degrees on a circle having a radius of 49½ feet. They then extend to within 25 feet of the front of the masonry, where they meet the cable wires. The bars have an average length of 12½ feet; the first three sets have a section of 7 by 3 inches, the next three 8 by 3, the next three 9 by 3 inches; the tenth set is double in number, and each 1½ by 9 inches section.

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Piercing the center of the anchor-plates are two parallel sets of apertures, each set containing 9 holes. A bar is passed through each hole, and a bolt, or key, run through the eyes, or holes, which are in the end of each bar. These bolts bear firmly against the under side of the anchor-plate, and serve to distribute the strain to every part of the plate. The next series of bars are attached to these by a bolt 5 feet in length and 5 inches in diameter. In this manner the succeeding bars are united, forming a chain having very long links connected to each other by bolts passing through the eyes. These bolts vary in size from 5 to 7 inches in diameter, according to the strain to be placed upon them. At each knuckle of the chains a large piece of granite was placed with a heavy cast-iron plate inserted as a bearing for the heads of the links. The bars in the last link are increased in number to 38, and are arranged in four courses, one above the other. The wires of the cable are divided into 19 strands, and each strand is fastened around a grooved eye-piece so as to form a loop.

The total dead weight in the anchorage is about 1,000,000 pounds, and the weight on the anchor plates is about two and one-half times the force exerted by the cables against it.

It now becomes necessary to get a rope from one anchorage to the other passing over the two towers. To do this a reel containing the first ropes was placed in a frame erected on a scow, moored in front of the Brooklyn tower. The end of the rope was then hoisted over the tower and drawn down on the other side into the yard. Here it was fastened to a rope leading to an engine on the anchorage. Carefully it was hauled over, men being on the intervening buildings to protect them from injury. The scow with the reel was then towed across the river to the New York tower, where the other end was carried over the tower and down into the yard to the engine which had been used to hoist stone. Men were now stationed on the tower to watch the craft in the river, and when an open space with no boats near was obtained, word was given the engineer, who started up. Gradually but surely the rope was drawn over the tower; leaving the water, it rapidly rose until the desired deflection of 80 feet was reached.

A second rope was taken over in the same manner. After having been fastened to the top of the tower, the ends of the two ropes were hauled over the buildings to the New York anchorage. The ends of these ropes were spliced together around the driving and guiding wheels placed on the New York anchorage, thus forming an endless rope moving to and fro. In this way the first path across the East River was placed in position. This traveler was made of galvanized steel wire, three-quarters of an inch in diameter. Shortly after another traveler was erected alongside of this one, the ropes being carried over by the one already up. The first rope was taken over August 4, 1876, and eleven days after Mr. E. F. Farrington, master mechanic of the bridge, passed over the span, seated in a boatswain's chair. After this there were suspended a "carrier" rope 1¾ inches in diameter, and designed to bear the weight of the heavier ropes while being carried over; three cradle ropes 2¼ inches in diameter for supporting the cradles; two foot bridge cables; one auxiliary rope; two storm ropes attached to the foot bridge, and to each of the towers below the roadway, in order to prevent the wind from lifting the foot bridge; two ropes for hand rails for the bridge.

The cradles, ten in number, were nearly 48 feet long, placed perpendicular to the axis of the bridge, and arranged so that the strands of the main cables would be within easy reach of the men. The foot bridge was made of oak slats 3 by 1½ inches, laid two inches apart, and fastened to longitudinal strips which were secured to the ropes.

All the work we have heretofore described was erected for the purpose of holding in position 6,800,000 pounds of steel cable wire. These wires are made of hardened, tempered, and galvanized steel, size No. 8, full, Birmingham gauge. A length of fourteen feet weighs exactly one pound. Each wire has a breaking strength of not less than 3,400 pounds, which is equal to 160,000 pounds per square inch of solid section. As the cables were to be suspended in a salt atmosphere, galvanizing was deemed the only sure safeguard against corrosion, and this was done at a temperature that did not affect the temper of the wire. Every known prevention was taken to have the wires conform to the standard as set forth in the specifications, and every lot was critically examined by inspectors appointed by the bridge, and pieces cut from the delivered rolls were being constantly tested by engineers. The cable making machinery was located on the Brooklyn anchorage. Each traveler ran around a driving wheel 11 feet in diameter on an upright wrought-iron shaft, and by three guiding wheels. On the New York anchorage the traveler ran around two 4 foot wheels placed on a sliding frame, so that the slack in the rope could be taken up. These wheels were made of oak.

Placed in the wire shed on the Brooklyn anchorage were 32 drums having a diameter of 8 feet, face of 16 inches, and a depth of rim of 6 inches. These were to act as reels for the cable wire, and their working capacity was about 50,000 lineal feet. The first operation in actual cable making was that of adjusting four wires to be used as guides in obtaining the exact deflection of the balance. This was done by selecting four wires of uniform size and weight, and by adjusting them by referring to a tangent line for the land spans whose position had been calculated, and to a level line tangent to the lowest point of the curve for the center span. Allowances were made for the temperature prevailing at the time. A wire was fastened to the shoes in the anchorage, and then passed around a sheave which was attached to one rope of the traveler by iron arms from its axle.

The sheave carrying the bight then started on its journey to the other side, the speed of the traveler averaging 5½ feet per second, and as the wire ran out at twice the rate, 11 feet of wire were placed per second. On reaching the New York side the bight was passed around the shoe, when the sheave returned empty. The adjusting of the wire was commenced at the Brooklyn side. A tackle was attached to the wire as it passed over the Brooklyn tower, and it was hauled until the men stationed in the cradles previously mentioned signaled that it was up to the proper elevation, when it was held in that position on the tower. A tackle was then fastened to that part passing over the New York tower, and the river span was raised until pronounced all right. A similar operation was repeated between the tower and anchorage on the New York side, and the slack was taken around the shoe. The whole programme was again gone through with with the other wire, but in a contrary direction.

A strand consisted of 278 wires, and the first or lower one was finished and attached to the bars July 14, 1877. To keep the strands apart and prevent chafing, they were seized throughout their length at every 2½ feet and wrapped by about 5 turns of No. 14 annealed wire. Experience on the first strands showed that no difficulty would be experienced in obtaining a larger wire, and therefore it was increased to No. 7 instead of No. 8. This gave 11 feet to the pound instead of 14. After 12 strands had been finished, the central 7 (which formed the core of the cable) were brought together and bound at intervals. The last wire in the cables was run over October 5, 1878, and the 19 strands of the four cables were in place.

At a distance of 21½ feet from the anchor bars heavy clamps were put on the cables to draw them to a cylindrical form. This was made necessary, as the anchor bars spread so as to cover a space 5 feet square. The final work of wrapping the cables was now begun. The wrapping wire was No. 10, charcoal iron wire, drawn hard and galvanized. The wrapping wire was put on with a machine, and was very tightly drawn. The binding wires on the core were cut and clamps screwed on the cable in advance of the wrapping. As the work progressed, the whole was saturated with linseed oil.

As the bundles of cable wire came in comparatively short lengths, joining was frequently necessary. The coupling was made of Bessemer steel wire 0·281 of an inch in diameter and 1⅛ inch long. This was drilled, and a right and left screw cut in each end respectively. Reverse threads being cut upon the ends of the wire, the coupling was screwed up. After having been galvanized, the joint was equal in strength to the wire. The cables are 15¾ inches in diameter, and each one contains 3,515 miles of wire, wrapped by 243 miles of wire.

Passing over the towers alongside of the cables are a number of stays of steel wire rope. These stays are attached to the trusses carrying the floor system, and reach to a distance of about 400 feet from the towers, and at intervals of 15 feet. They are designed to sustain a portion of the load and to prevent vertical vibrations.

As the cables pass over the towers they rest in saddles, the object of which is to furnish a bearing with easy vertical curves. In plan they are rectangular, 13 feet long by 4 1/12 feet wide, and have an extreme height of 4¼ feet, and a thickness of 4 inches. One cable passes over the center of each through a groove 19½ wide and 17¼ inches deep at the center. There are two smaller grooves on each side of the large one, in which four of the long stays are situated. Wherever there is a possibility of chafing the wire, the ends and edges are rounded.

To reduce the weight and secure uniformity in thickness, 17 openings were made beneath the grooves. Longitudinal edges are extended 1 inch below the under surface of the saddle to make bearings for iron rollers to be described shortly. The inner faces of these edges are true, and the under surface is planed so as to bear a straight edge in any direction.

The saddle-plates rest in seats prepared in the masonry and form absolutely true beds, on which the rollers travel. They are 16⅛ feet long and 14¾ inches high, the outside ones 8 feet wide at the center and 6¼ feet at the ends; the inner ones being 6½ feet wide at the center. The central portion is 4½ inches thick, and the sides 3¼ inches. The central channel is planed perfectly true, and the edges that form bearings for the rollers are also planed true.

Each saddle weighs about 25,000 pounds, and each saddle-plate about 11,000 pounds.

Between the saddle and saddle-plate are steel rollers, along which the saddle is free to move. By this means the cables are free to move backward and forward, and not only to accommodate themselves to any unequal loading that might occur during construction, but also to adapt themselves to changes caused by alterations of temperature and load after completion. All liability to wear while moving was thus obviated.

The floor system of the bridge consists of six longitudinal trusses, connected by floor-beams, the whole suspended from the cables by suspender ropes. Between the towers and on each side of them, with the exception of a short distance from each anchorage, the floors are below the cables. The suspender ropes are made of twisted steel galvanized wire, and are from 1⅝ to 1¾ inches in diameter. They are capable of sustaining about five times the load they will ever be called upon to bear, or about 50 tons. They are attached to the cables by wrought iron straps, ⅝ of an inch thick and 5 inches wide. The straps were placed on the cables when they were wound. The backs were heated in forges until they could be opened so as to admit the cable, when the two ends were drawn together, a thin plate of iron having been previously inserted between the cable and hot iron to prevent burning. The under side of the strap terminates in two lugs, ⅞ of an inch thick, through which passes an iron screw-bolt 1¾ inches in diameter, holding the wrought-iron closed socket on the upper end of the suspender rope. On the lower end of the rope is fastened a cast-iron socket having a hole in each end through which pass two stirrup-rods to hold the floor beam. These rods have long screw threads by which the beam can be raised or lowered.

As the floor system of the bridge is in a continuous line with the surfaces of the anchorages, and the cables leave the anchorages a few feet below, the floors rest on the cables until the latter rise above the grade. The beams are laid on posts varying in height to suit the distances, and braced by plate brackets. The lower end of the post is bolted to the upper half of a strap encircling the cable. The total number of suspender ropes is 1,520, and the number of posts 280.

The floor-beams were made in half lengths, and when riveted at the center made a continuous beam the width of the bridge, 86 feet from end to end. They are 32 inches deep, 9⅜ inches wide, and weigh 4 tons. Each one has two top and two bottom chords braced together, so as to form a triangular lattice girder. The chords are of steel channel bars. They are suspended 7½ feet between centers and an I beam placed between each pair, resting on truss chords, so that the planking will be supported at every 3¾ feet. The floor-beams were hoisted to the floor of the arches in the towers and then attached by ropes to their respective suspender ropes, when they were swung off, raised to the proper height, and the stirrup bolts inserted. Those immediately adjacent to the towers were placed first, and a track laid as fast as the work progressed, upon which the more remote ones were run out. The number of double floor-beams is 450.

The six longitudinal trusses which divide the bridge into five passage ways have the following heights, measured from the top of the floor-beams: The two outside ones, 7⅛ feet, the four intervening ones, 15 feet 7½ inches between the floor and bottom of the top braces. Across the central opening is a system of light beams supporting the foot way; this foot way is 12 feet above the floor-beams. The outside divisions are 18¾ feet wide in the clear, covered with plank flooring, and designed for vehicles. The next two are 12⅝ feet wide, and will be used by passenger cars. The central opening—the foot path—is 15 feet 7 inches wide, and the elevation of the walk permits an unobstructed view of the surrounding country. As the foot passenger approaches the tower he ascends five or six steps, and to avoid the central shaft passes through the arches on a flooring laid on the beams over the car tracks. The cars and vehicle ways go through the arches side by side.

To prevent horizontal vibrations and resist the force of the wind, there are wind braces placed beneath the floor-beams. These braces are large wire ropes, and are anchored at the four facing corners of the towers to eye-bolts set in the masonry. From the corners to which they are attached they passed diagonally across the floor-beams to the opposite side of the bridge, where they are secured. The longest ones reach about one-third way across. Similar braces are placed on the land spans. As a further precaution, and particularly to secure stability in the center of the span, where the braces are of little effect, the outside cables are drawn in a short distance toward the center.

To allow for expansion and contraction of the long trusses, expansion joints are inserted between the towers and anchorage and in the main span.

The total weight of the suspended superstructure, including cables, trusses, suspenders, braces, timber flooring, steel rails, etc., is 14,680 tons; and the transitory load is estimated at 3,100 tons, making the total weight of the bridge 17,780 tons.

We have now finished the bridge from anchorage to anchorage, and shall devote the remainder of our space to considering the approaches, stations, cars, moving cars, and financial statements.

The approach on the Brooklyn side is 900 feet long on the center line, and commences at street grade at Sands Street, rising 2·85 feet per 100 to the rear of the anchorage, where it is 60 feet above ground. It is crossed by several streets, and has one curve at about 200 feet from Sands Street. It is 100 feet wide throughout. All the streets are crossed by box or plate girders. The New York approach is 1,546 feet long, commencing at grade at Chatham Street, and rising 3·25 feet per 100 to the rear of the anchorage, where it is 68 feet above ground. It is 100 feet wide for about 500 feet of the distance, and 85 feet for the remainder. At Franklin Square is an opening measuring 210 feet on one side and 170 on the other, which is spanned by a truss bridge. The other streets are crossed by semicircular stone arches. The approaches are a series of arches resting on heavy piers with fronts entirely of granite. The cornice over the arches has a dentil course below, surmounted by a heavy projecting coping course. The cornice is surmounted by an ornamental granite parapet, 4 feet high. The arches in the approaches will be fitted up for warehouses, and in order to sustain great weight the floor beams will be of steel and wrought iron.

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Both the station buildings are constructed of iron. The viaduct to accommodate passengers at the Brooklyn end is about 600 feet long. Beginning at Sands Street it is 56 feet wide (the two passage ways for vehicles are at either side of the building) for 205 feet, of which 185 feet is roofed and inclosed on the sides. This forms a building, the ground floor of which is used by foot passengers, with the exception of a waiting room, 60 by 18 feet, on the left as we enter. The next floor is at a height of about 20 feet above Sands Street, and contains three lines of rails in the central space and two capacious passenger platforms, one at each side, and raised 2¼ feet above the rails. These platforms extend to some distance beyond the end of the building. The sides of the building from the main floor to the eaves of the roof are of ornamental cast-iron work and glass. The lantern framing is over the center of nearly the whole length of the building, and is 14 feet wide by 3 feet high. The car passengers enter the waiting room below, pass up wide stairs to the platform, and enter cars on the right track. Incoming passengers get off on the other side.

The New York station is 260 feet long by 52⅛ feet wide; the height to peak of small roof at rear end is 52½ feet, at front end 61 feet. The general arrangement is very similar to that of the other station.

The twenty-four cars are like those now in use on the elevated roads of this city. They are 44 feet between couplings, 9½ feet wide from out to out, and will comfortably seat 48 passengers. In the middle of the car the seats are placed crosswise, leaving an aisle between; near the doorways they are placed along the sides.

The cars are moved by being attached to an endless rope operated by powerful engines situated beneath the Brooklyn approach. This steel wire rope, 1½ inches in diameter, passes over the bridge in the middle of the right railway track, and returns along the other. It is supported throughout its length on 490 pulleys, placed 22½ feet apart. Motion is communicated to the rope by winding it three times around a pair of grooved driving drums, placed facing each other. These drums are made of cast iron, 12 feet in diameter, and have faces 27½ inches and 26 inches across respectively.

The drums are revolved by means of a friction drum placed between them, and being 5 feet in diameter and 31½ inches across the face. This drum is mounted upon a shaft of hammered wrought iron 12 inches in diameter, and at each end of the shaft is a crank to which the engines are attached. By means of a clutch at each end of the shaft the engines can be worked alone or together. The engines have a variable cut-off, 48 inches stroke, 26 inches diameter of cylinders, and will work safely with 100 pounds of steam. The boiler house contains 4 boilers, and is placed in a separate building located to the right of the approach. From the driving drums the rope passes upward and over a grooved sheave 10 feet in diameter, and a loop is then passed around another sheave of the same size, mounted on a heavily loaded car moving on a steeply inclined plane, thus serving as a balance weight to draw the rope tightly. The returning part of the rope goes under a third sheave, then up over a summit sheave placed between the rails, and then out on the pulleys. The switching of the cars on this side is done by dummy engines.

Just before the New York station proper is reached, the rope is passed down over a summit sheave around return sheaves to the other track, up over another summit sheave and back to the Brooklyn side. Before leaving the New York side the rope passes over and then under two sheaves placed near together, thereby giving them motions in contrary directions. On the shafts of these sheaves are small grooved friction drums, which can be pressed by a lever against either sheave according to the direction of the revolution desired. Wound about these two drums is an auxiliary rope leading into the station. After the car has discharged its passengers, it is attached to this auxiliary rope, which takes it to the upper end of the station. The grade of the road is such that upon being released the car descends by gravity to its station at the other platform, where it meets the endless rope over the bridge.

The engineers are not prepared to make public the plan of the clutching device by which the cars will be attached to the rope. From end to end the bridge is lighted by arc electric lights, the dynamos and engines being under the Brooklyn approach.

On the 31st of last March the financial condition of the bridge was, briefly stated, as follows:

Cash received from New York	$4,871,900 00
" " " Brooklyn	9,423,692 73
" " " rests interest, sale of material, etc.	391,463 93
Total	$14,687,057 66
There is still due from the city of New York	216,666 66
And from Brooklyn	433,333 34
Total cost of Bridge	$15,337,057 66

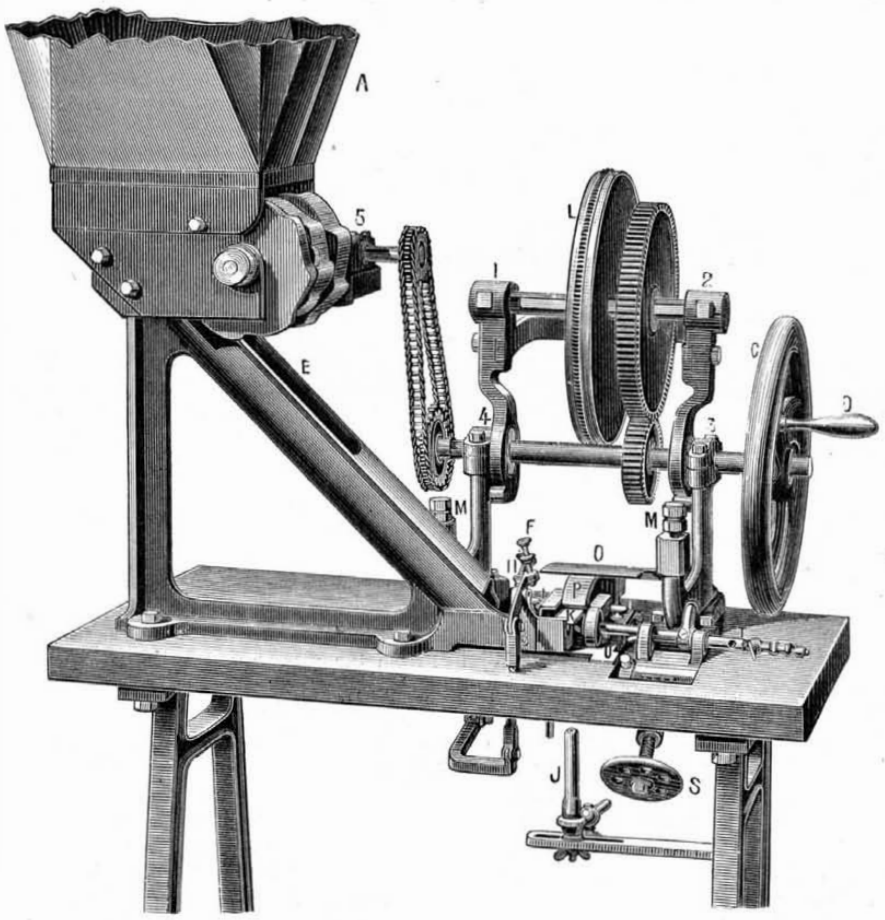

Fig. 1.—MACHINE FOR BRANDING CORKS AND STOPPERS.

Some of the principal items of cost up to March 1, were:

Engineering, salaries, etc.	$498,963 68
Office expenses	167,446 41
Timber and lumber	469,031 23
Construction	3,128,969 46
Labor	2,416,151 33
Machinery and Tools	161,015 56
Land, damages, and buildings	3,780,988 94
Limestone	668,041 37
Cast steel cable wire	623,733 16
Granite	2,129,004 93

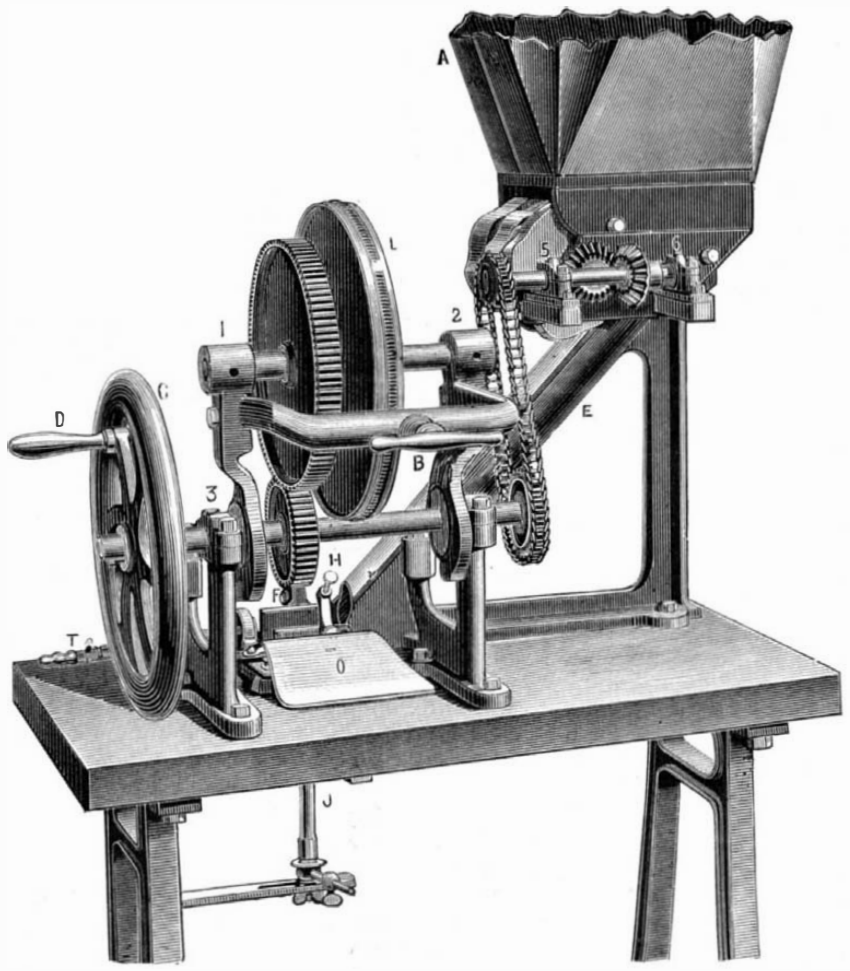

Fig. 2.—MACHINE FOR BRANDING CORKS AND STOPPERS.

The names of the engineers who planned and so successfully executed this work are:

JOHN A. ROEBLING.
WILLIAM A. ROEBLING.
C. C. MARTIN. W. H. PAINE.
F. COLLINGWOOD. G. W. MCNULTY.
S. R. PROBASCO. W. HILDENBRAND.
E. F. FARRINGTON.

MACHINE FOR BRANDING CORKS AND STOPPERS.

A number of machines for marking corks with hot irons have already been invented, but as a rule these machines have been designed to mark the cork only on its circumference. The machine which we describe below was invented by M. Chenet, and constructed by M. Leclère, of Paris, France. It differs from the machines which have been in use heretofore in that by one process it marks both the circumference and one of the ends of the cork. The machine Chenet is represented in elevation in the engravings given.

The corks are thrown loosely in the receiver, A, at the bottom of which is arranged an inclined duct, through which the corks are pushed one by one under the action of a wheel provided for the purpose, and constructed with two rows of bent teeth similar to those on a ratchet wheel. This wheel is connected with the crank, C, from which it receives its power by a sprocket wheel connected by an endless chain and by two miter wheels.

Each cork as it leaves the duct is guided by a screw and placed in a horizontal position by means of a suitable stop, against which it is brought in contact. At this instant the stop falls and the cork receives at its end the imprint of the brand, U, being held during this operation by the vise, F, which is attached to a lever that falls on the cork the same instant that the stop is withdrawn.

When this is accomplished the mark is pushed back by a spring, and the stop, as well as the lever, resume their original position. The cork thus branded on one end is now seized by the wheel with the serrated or grooved felly, L, which is represented in the drawings as raised and out of the way. The shaft, 1 2, which carries this wheel, being mounted upon the two levers, 1 4, 2 3, and united by the stirrup, B, may be given any position required by revolving it around the axis of the crank wheel, C. This arrangement is made with a view of rendering the wheel movable vertically when placed upon the cork, so that it may receive under the felly corks of a different size. The wheel, L, rests, as we have said, upon the cork already marked upon one end, and being put in motion by the crank wheel, moves the cork forward and rolls it to the point of discharge from the machine. Furthermore, the cork in being rolled along, passes over a key, which is not shown in the drawing, and which actuates on the one hand the screw, H, and on the other a marker. The cork then passes over a second brand, K, which acts upon the circumference of the cork; and finally it passes over a key which terminates in an inclined plane, after which the cork falls into a basket and the operation is completed. The same machine, with a few modifications in the details, could be used to mark corks upon both ends.

Rendering Cement Airproof.

A method of rendering cement impervious to air has been successfully practiced by Herr C. Pascher. This experimentalist claims to have found that the only way to render cement unalterable by atmospheric influences is by the application of a cold solution of 1 part of sulphate of iron in 3 parts of water. The articles to be protected should be left to soak in the solution for twenty-four hours, when they take a greenish black tint from the hydrated protoxide of iron. The absorbed solution is decomposed in the interior of the cement, which is increased in weight 10 per cent. All the pores of the mass are thus stopped by the hydrate; and as this compound is not attacked by air, the cement itself becomes impervious. Cement facings may be washed down with several coats of the solution. When dry, the cement may be covered with a wash of ocher, or by a solution of sulphate of alumina. If a greenish white face is desired, the surface may be first washed with a solution of chrome alum, and then with soapsuds. Either of these coats may be painted or colored in distemper. It has been observed that when oil colors are laid upon bare cement they easily peel or scale off; but this inconvenience may be avoided by washing the cement thoroughly with soapsuds, and when perfectly dry rubbing with a brush or linen cloth until the surface shines. Afterward the oil colors may be applied in the usual way.

A BRASS cannon, 6 feet long, has been found by an agriculturist, while plowing, at Coorum, near Soopa, in the Bhimthudy talooka. This cannon, it is said, was manufactured by Michael Burgerhays, and is dated 1640.

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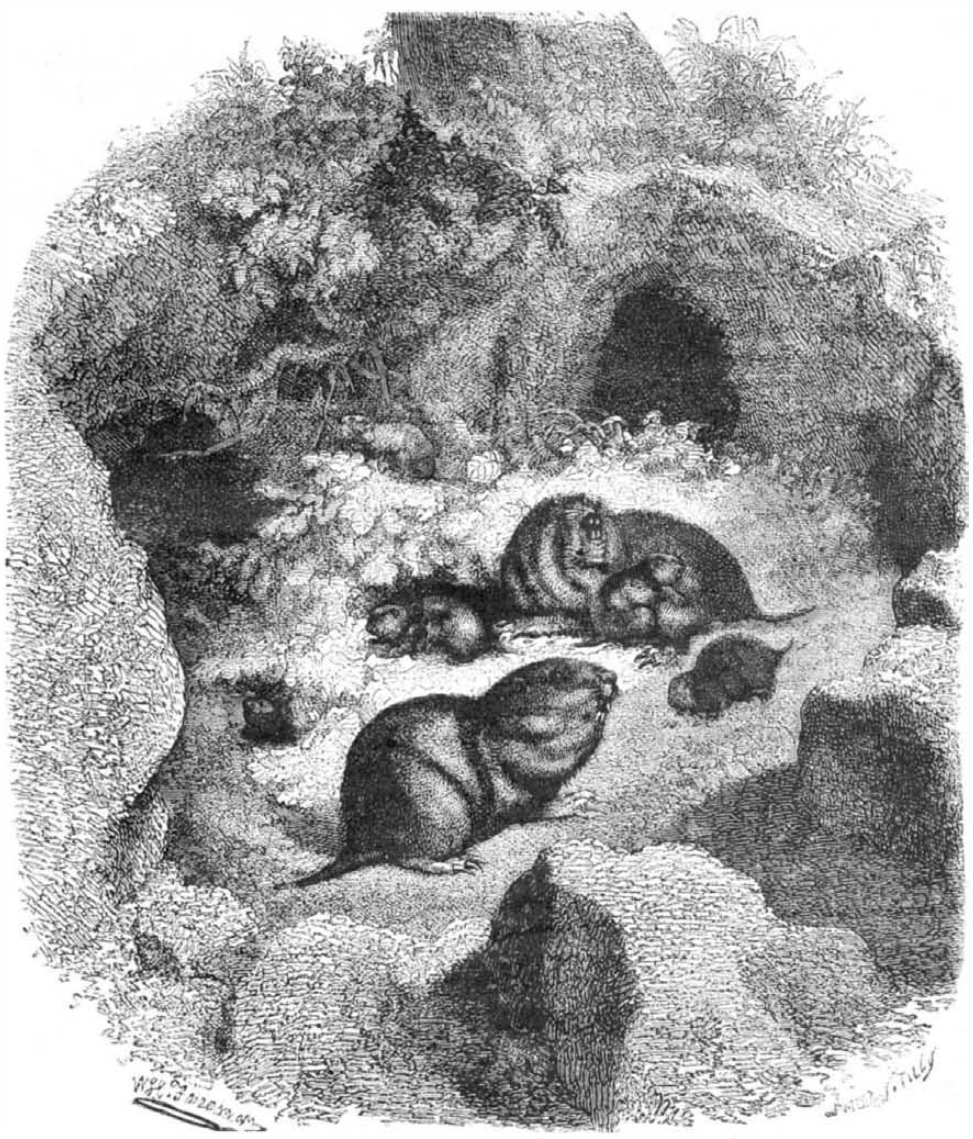
THE POUCHED GOPHER.

The pouched gopher, pocket gopher, or pouched rat (*Geomys bursarius,* Rich.) of the Northwestern States is a small rodent ten to twelve inches long, including the tail. Its color is reddish-brown above, paler beneath, with a plumbous tinge along the vertebral region. This little animal is remarkable for its large head, which is almost as thick as its body, for its large incisors, which project from its mouth, and for its cheek pouches, which are very large, which extend as far back as the shoulders, and are lined with short hair. These pouches are capable of distention, and are used mainly or wholly to convey food into the burrows, to be stored up or eaten at leisure. The animal's paws, which are short, terminate in strong and sharp claws.

The gopher leads a subterranean life, digging burrows in which it remains most of the time. Outside of these excavations are usually seen, here and there, heaps of earth similar to those made by the mole, but which are usually closer together and arranged in a zigzag manner.

From the observations of those who have examined these subterranean galleries made by the gopher, it appears that they first run longitudinally and then meet in one center in common, where they end in several circular galleries, in the midst of which is situated the principal chamber, this being usually at a depth of from three to five feet beneath the surface of the earth. This chamber is capacious, and is lined with soft grass. This is the covert and nest of the animal, in which it remains asleep during a great part of the winter. These little animals scarcely ever leave their retreat except in summer, and then only in fine weather, when they go out to gather food, as well as material to line their dwellings. Their motions above ground are heavy and awkward, and, when they chance to turn over on their back, they have difficulty in regaining their feet. Under ground they move with greater facility, and they burrow as quickly as the mole.

These rodents cause great havoc in planted grounds, since they gnaw off all the roots that come in their way. They have been known to ravage whole fields of tuberous plants. Many attempts have been made to keep gophers in captivity, but they almost always succeed in gnawing through their cages and escaping. Audubon had one which, having got into one of his boots, found it more convenient to gnaw through the toe and get out in that way than to turn about and make its exit through the leg, where it had entered.



THE POUCHED GOPHER.

Firing Torpedoes by Steam.

Some interesting trials lately took place at Westminster with a second-class torpedo boat recently built for the English Government by Messrs. Yarrow & Co., in order to illustrate the new system of steam impulse introduced by them. The arrangement consists in building two troughs inclined at an angle of five degrees in the bow of the boat, which are provided with suitable guides for carrying the Whitehead torpedo. Aft of these troughs or guides are two long steel steam cylinders, 6 inches in diameter and 7 feet stroke, the piston rods of which press against the ends of the torpedoes. Upon steam being admitted into these cylinders, the torpedoes are instantly forced out with considerable velocity, the speed being estimated at about fifteen miles an hour. If, therefore, the impulse is given when the boat is going twenty miles an hour, the total speed of the torpedo upon entering the water is clearly thirty-five miles an hour. The arrangement is exceedingly simple and under the entire control of the steersman.

Hydraulic Silica.

If a solution of potassium or sodium silicate (water glass) is decomposed by an acid, gelatinous silicic acid separates. If this be dried at a red heat, and the operation repeated until the alkaline salts are entirely removed, a pure silicic oxide (silica) is obtained that is insoluble in acids. Landrin says it is the source of the real hardening of hydraulic mortar.

In certain cases the aluminate of lime is a help to the setting of the cement, somewhat as gypsum would be, for, notwithstanding its slow solubility, it renders the combination of the hydraulic substances easier at the first immersion and prevents the rapid entrance of water into the mass of the mortar, which is favorable to the slow and gradual union of the lime with the hydraulic silica. It is a fact, for instance, that the lime from Theil, which contains none of the aluminate, cannot be used for hydraulic constructions in the ocean because it crumbles before it sets, while it has proved very valuable for use in the Mediterranean Sea.—*Compt. Rend.*

NATURAL HISTORY NOTES.

The Largest American Trees.—The largest specimen of wood that has thus far been received by the Central Park Museum is a section of the white ash, which is forty-six inches in diameter and eighty-two years old. The next largest is a section of the *Platanus occidentalis*—a tree known in various sections of the country as sycamore, buttonwood, plane, etc. This section is forty-two inches in diameter and only one hundred and seventy-one years of age.

Vegetable Parasitism in Fishes appears, from recent observations made by Messrs. Olivier and Richet, to be so constant that it may be regarded as normal. These gentlemen examined about 150 fishes taken in the Channel and the Mediterranean, and in all of them they found in the peritoneal liquid, in the lymph, in the blood, and so in all the tissues, microbes more or less numerous, having all the characters of land microbes and being capable of similar reproduction. These organisms were mostly the bacterium called *Bacillus.* The authors cultivated these microbes successfully. They also repeatedly made an experiment which consisted in putting a whole fish or part of it in paraffine melted at 120° or 140°. After solidification, the paraffine was coated with several layers of collodion and Canada balsam. The tissues thus guarded from atmospheric germs all showed, after a few weeks, an extreme development of microbes which were not those of putrefaction. The authors propose to investigate the mode of penetration of these parasites and their influence on the vital functions.

Stamens of Heteranthera.—Fritz Muller communicates to *Nature* some interesting facts with regard to plants which have differently colored anthers or pollen in the same flower, or stamens of different length. Thus in *Heteranthera reniformis* insects visit the short stamens with yellow anthers while fertilization is effected by the longer stamen with pale blue pollen. He suggests that the green color of the anthers of the longer stamens of the mid-styled and shorter styled flowers of *Lythrum salicaria* may protect them against the attacks of pollen-eating insects. In a species of *Cassia* he has noticed that the humble-bees which visit it gather the pollen of the four intermediate stamens, the three upper ones being pollenless, while the three lower ones, which are very long and curved, deposit their pollen on the backs of the insects, whence it is taken by the similarly curved and elongated style.

The Colors of Feathers.—At the close of a valuable paper in the Proceedings of the Zoological Society of London, on the colors of feathers, Dr. H. Gadow sums up his conclusions as follows: We have to distinguish between several categories of colors in feathers: 1. *Objective chemical colors,* directly produced by pigment. To these belong black, brown, red, orange, and yellow. 2. *Objective structural colors.* The feathers may contain no pigment at all, and the color be produced solely by special structural arrangement of the feather substance, for instance, white, and frequently yellow; the latter, if the surface is composed of very fine and narrow longitudinal ridges. Or the feather contains a yellow to brownish black pigment, and the color actually observed, as *green, blue, and violet,* is produced by a specially produced and particularly constructed transparent layer between the pigment and the surface of non-changing colors, *blue* and *violet* are always structurally objective. *Green* seems to be only in a few cases the result of yellow pigment combined with blue surface structure. In most cases it seems to be not a mixture of two colors, but due to yellow pigment light being broken into green. A green pigment seems to be very exceptional. 3. *Colors which change and which entirely depend on the position of the light and eye.* They are produced by a transparent sheath, which acts like a prism. Any changing color represented in the solar spectrum may be thus produced in feathers.—*American Naturalist.*

The Regulative Action of Birds upon Insect Oscillations.—The question, "Do birds sometimes vary their diet so far as to neglect their more usual food, and take extraordinary numbers of those species of insects which, for any reason, become superabundant for a time?" is answered by Professor Forbes (*Bull.,* Ill. State Laboratory) in a very conclusive manner. He selected an orchard which had been for some years badly infested by canker worms; shot a considerable number of birds therein for two successive years (54 birds of 24 species the first year, and 92 birds of 31 species the second year), representing nearly all the kinds seen in the orchard; made full notes of the relative abundance of the species; examined carefully the contents of the stomachs obtained, with reference not only to the presence of canker worms, but of all other insects as well; and tabulated the results. The summaries on these tables are brought into comparison with those derived from birds of the same species shot in ordinary situations during the same month. Thirty-six species of birds were taken in the infested orchard; 72 per cent of the species, and 60 per cent of the specimens, had eaten canker worms; 35 per cent of all the food eaten by all the birds was canker worms. The comparisons made between the food of these birds and that of birds shot in other situations show that the large proportion of the food which the canker worms constituted in one case was compensated by a general diminution of the ratios of all the other kinds of food, and not by a neglect of one or two alone. Hence the birds, in checking the increase of the canker worm, were not tending to allow an undue increase of any other species of insect.—*Science.*

The Rose Polytechnic Institute.

Chauncey Rose, a rich bachelor of Terre Haute, Ind., who died a few years ago, provided in his will for a grand school of technology in that city. A splendid edifice and complete workshops were built some time ago, and on March 7 the school was formally opened with a class of twenty-five students selected by competitive examination from forty-five applicants. Charles O. Thompson, eminent in his profession, from Worcester, Mass., is president. The press report of the State remarks: "This event is one of the most important in the history of education in this State, the institution being the first of the kind established in the West. The institution, in addition to the buildings and property, has, according to the *Minnesota Trade Journal,* an endowment fund of near $500,000, left to it by its founder at the time of his death in 1878."

A fair notion of a few of the leading ideas of this new Western enterprise may be obtained from the following extracts from President Thompson's opening address:

"The Almighty makes superintendents and leaders of men—no school can. But the training required for a superintendent must be that of his subordinates. All the best experience of the world sanctions this rule. A superintendent who has not had the training of the shop is as useless as Achilles without his weapons; he may seem and assume to direct and to lead, but he does not. On the other hand, the man who attempts to lead without natural leadership is as useless as the weapons without Achilles."

BARON HAUSSMANN explains the distress of the Parisian cabinetmakers and carpenters as due to the vast importation of ready-made deal furniture, rafters, window frames, lattice blinds, etc., from Norway and Sweden. It is much cheaper to get them made there and transport them to France than to manufacture them in Paris, where wages are very high and the purchasing power of money low. This importation is new. It began after the last universal exhibition, when the building trade was in full activity.

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RECENT INVENTIONS.

Railroad Switch.

This invention consists of a switch lever contrivance and apparatus attached to the locomotive for enabling the switch to be shifted by the locomotive or not, at the will of the engineer, the shifting apparatus being contrived to be set by steam for shifting the switch to right or left. The switch is self-locking, and is so arranged that when open the switch rails can be shifted by the wheels, so as to pass it in one direction, after which the rails will be shifted back by a spring arrangement in the switch bar, so contrived for enabling the train coming upon the main line and wanting to back off over the switch to change the switch before passing it, so that after passing the switch it will be set for backing off on the branch. The engineer has by this contrivance full command of the switch, whichever way his train may be moving and whichever way the switch may be, whether open or closed, and, at the same time, the switch can be shifted by hand, if required. Fig. 1 is a plan view of the switch. Fig. 2 shows the steam switch operating mechanism. This ingenious device has been patented by Mr. Albert T. Fay, 715 Fourth St., S. E., Minneapolis, Minn.

Fig. 1.

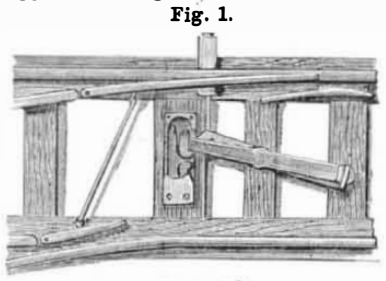
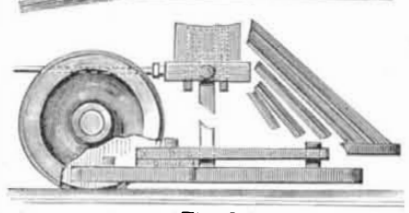


Fig. 2.

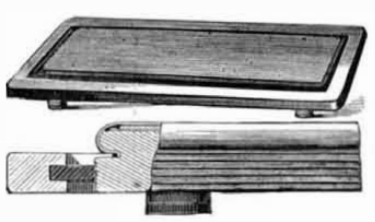


New Telephone.

The cut below shows one of the Bennett Telephone Company's instruments complete. For a private line telephone they are excellent, using no battery. A magneto bell generates all the electricity necessary for signaling. This company sells the instruments outright instead of renting them. Business men will find them very convenient in connecting the various departments of a store, factory, or outbuildings. Three to seven instruments may be connected in a line, or by means of their key board any one instrument may be rung. Right angles may be put in the line without the least detrimental effect. The instrument has a patent earphone attachment, and, as we are informed, the telephone is covered by six United States patents. The general office and factory is at Indianapolis, Ind.

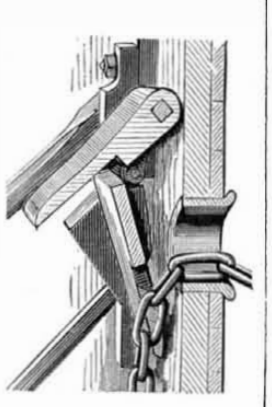
Bosom Stretcher and Ironing Board.

The engraving shows a very simple and practical device for stretching the bosoms of shirts and holding them taut while being ironed. The invention consists in an ironing board combined with a frame having rubber strips projecting from its inner edges; this frame is passed over the board to hold the shirt. The ironing board is provided on its sides and ends with corrugations to prevent the edges of the rubber strips of the frame from slipping. By means of this device it is claimed a child can iron a shirt bosom as well as the most experienced person. There is nothing about this stretcher to tear or injure a shirt. It gives the bosom the proper shape, and is very easily used. This useful invention has been patented by Mr. A. C. Gibson, 377 Fifth Avenue, Chicago, Ill.



Cable Stopper.

The engraving shows an improved cable stopper recently patented by Mr. John B Lynch, of Leadville, Colo. A frame having an opening at the center is closed by a door secured upon a shaft at one end of the frame. The upper part of the door is formed of a piece secured to the shaft, and hinged to the lower piece, the latter having its free end provided with a slot through which the chain passes. The slot is made narrow at its inner end, with parallel sides, and broadly flaring at its outer end, with its edges beveled on the upper side. The frame is provided with vertical guides on each side of the doorpiece, by which the movement of the lower part is confined to a direct line and great strength is given to the piece. The shaft is provided with suitable bearings at one end of the frame, and is connected to a lever by which power may be applied to operate the door. The frame is to be bolted to the bow of a vessel, and is further strengthened by stay rods which are to extend to the deck. When the door is shut down it engages the chain, and when it is opened by means of the lever it releases the chain.



Hood for Vehicle Tops.

This is a hood to be attached to the front of the tops of vehicles for preventing rain or snow from driving over the top of the apron. The hood is formed of a frame, which is covered with oil cloth or leather, as may be desired. The frame is formed of two bows which are pivoted to each other at or near the ends, and are of such size that one bow can fold within the other bow, as shown. Both bows are provided at the middle with a suitable joint to permit of folding the bows. Bracing straps are attached to both bows to prevent the outer bow from swinging down too far, and to relieve the covering from the strain. If the cover is made of very strong material, the brace bands can of course be dispensed with. A clamp hook is attached to each end of the larger bow and provided with a binding screw for securing it to the fixed front bow of a carriage top. When the hood is not to be used, the clamping screws are loosened, the hood is removed, the bows are folded, as shown in Fig. 2, and then can be conveniently stored in or under the seat. This invention has been patented by Mr. Charles T. Shreve, of Haddenfield, N. J.

The Force of Nitro-glycerine.

Mr. G. M. Roberts, manager of the Nobel's Explosives Company, London, writes as follows to the London *Times:*

Nitro-glycerine and dynamite do not, when exploded, exert such a force as is popularly believed. To speak precisely, the power developed by the explosion of a ton of dynamite is equal to 45,675 tons raised one foot, or 45,675 foot tons. One ton of nitro-glycerine similarly exploded will exert a power of 64,452 foot tons, and one ton of blasting gelatine, similarly exploded, 71,050 foot tons. These figures, although large, are not enormous, and need not excite terror. Seventy-one thousand tons of ordinary building stone, if arranged in the form of a cube, would measure only 90 feet on the side, and if it were possible to concentrate the whole force of a ton of blasting gelatine at the moment of explosion on such a mass, the only effect would be to lift it to the height of a foot. The foregoing figures are derived from experiments made at Ardeer with an instrument which gives accurate results in measuring the force of explosives. The power exerted by an explosion on surrounding objects is in the inverse ratio of the cube of the distance from the point of explosion. Thus, at 100 feet from the exact point of an explosion the power is only the cube of $\frac{1}{100}$ or $\frac{1}{1000}$ part of what it is at a distance of only one foot from that point; or, in other words, if the power at one foot from the spot be represented by 1,000,000, at the distance of 100 feet it will be but 1. It is thus seen that the effects are intensely local, but comparatively trifling at even short distances.

If a ton of dynamite or nitro-glycerine were exploded in a London street, the effects would be felt severely in the immediate neighborhood only of the explosion, and beyond that they would be confined to the mere breakage of windows. Indeed, it would be impossible by a single explosion, however large, to do damage to any considerable extent beyond the immediate neighborhood in which the explosion took place. On one occasion I happened to witness the explosion of over a ton of nitro-glycerine from a distance of only 60 yards. The nitro-glycerine was about 10 feet beneath the level of the ground, which was of sand and covered with water. Beyond the breakage of windows and the bursting of a few doors in the surrounding buildings there was no damage done. A little sand was thrown over me, but I received no personal injury.

Vague statements have been from time to time promulgated to induce the belief that there are stronger explosives than nitro-glycerine and nitro-glycerine preparations, and that the wretched men who have been guilty of the late attempts on public buildings, etc., are in possession of more powerful explosives than any known to chemists. The public may rest assured that such is not the case. Nitro-glycerine and its preparations form the strongest explosives yet known. The strongest of these is the material known as blasting gelatine. It consists of nitro-glycerine combined with a certain proportion of nitrated cotton. It is much more difficult to prepare than either nitro-glycerine or dynamite, and cannot be made by unskilled persons. If the power of dynamite be represented by 1,000, that of nitro glycerine will be 1,411, and of blasting gelatine, 1,555.

The 1½ cwt. of nitro-glycerine seized by the police the other day would, if exploded, exert a force of only 4,833 foot tons, and if converted into dynamite it would represent a force of only 4,567 foot tons. The conversion of nitro-glycerine into dynamite reduces the power of the former, but renders it more easy and safe to handle and use. The power given above is comparatively insignificant, and as it is the *maximum* effect that could be produced under the most favorable circumstances on the very spot of explosion, it never could be obtained in practice. It is therefore absurd to say, as was said the other day in a London paper, that the explosion of such a quantity of nitro-glycerine would blow up the whole of London. In fact, the explosion could scarcely be heard over London, and the damage done by it would be strictly local.

I have often, by way of experiment, exploded a pound of dynamite suspended from the end of a fishing rod by a string about 6 feet long, holding the rod in my hand the while. As there was no solid matter to project I received no injury, and the end of the fishing rod was not even scratched. About 3 feet of the string at the end of the rod was always left uninjured.

It will be seen from the foregoing that the scoundrels who attempt to destroy public buildings are powerless to do much harm by their operations. They cannot by any means at their disposal lay a whole city in ruins—not even a street. They may injure special buildings, but that is the most they can do.

Gelatine Plates Treated with Eosine.

At the last meeting of the Photographic Society of France were presented, in the names of MM. Clayton and Tailfer, two photographs of the same piece of material striped with deep blue, light yellow, orange, and violet. The ordinary photographic impression of such a stuff would give the effect of the blue being paler than the light yellow, and violet lighter than the orange. One of these two prints, from an ordinary gelatino-bromide plate, gives this effect. The other photograph, from a specially prepared plate, gives the true relative luminosity of the colors; that is to say, the yellow, a hue more luminous and lighter in tone to the eye than deep blue, is rendered by a tone conforming to this effect. It is the same with the orange and deep violet. The reagent employed by MM. Clayton and Tailfer to modify the nature of the sensitive film is eosine, a substance already indicated with this intent in 1876, in the *Photographic News*, by Major Waterhouse. M. Sarrault has actually used it on collodion plates; but the inventors named above, in applying it to gelatine plates, have had recourse to ammonia as a solvent for the eosine. To the emulsion one per cent of this solution is added, and afterward proceed in the usual way. With plates already coated, the solution must be mixed with alcohol, and the liquid spread over the surface of the plate and afterward washed in water. It is to be hoped that the plates will come into general use, as the important result obtained gives a truer reproduction of the relative luminosity of various colors. The error will thus be avoided, in our present sensitive films, of treating light yellow, red, and green as if of darker tone than in reality. The reproduction of pictures will gain much by this, and polychromatic applications of photography will be also considerably improved.

Floors Weakened by Gas Pipes.

A short article in the *Building and Engineering Times*, on the subject of weakened floors, deals very intelligently with the harm that may be done in this direction by careless gas fitters. It is common enough, in cases where a pipe has to be led under flooring and across joists to serve a pendant, for the pipe to be taken straight across the center of the room, and the joists notched about an inch deep all the way. Workmen who do this never reflect on the harm they are doing to the floor, nor do they know that a notch cut out of the top of a joist will seriously weaken it. This at once becomes evident when it is known that the strength of a joist, which is a rectangular beam, is proportional to the depth squared. If, therefore, a groove 1 inch deep is cut across a 7 inch deal, the reduction of strength is not only one-seventh, but a great deal more, in the proportion of 36 to 49, or a loss of rather more than one-quarter of the original strength of the beam. This somewhat startling result is due to the self-evident fact that the upper part of the joist is required to be solid, in order to resist compression, just as much as the lower portion must be capable of bearing tension; and to cut a notch in the top of it is equivalent to removing the substance along the whole length of the joist to the full depth of the groove. This observation only applies to cases where the notch is cut out of the center of the span, which is the commoner practice. There is much less objection to cutting joists close to the end, and thus allowing the pipe to be laid round the room to a point where it can be run to the center between two joists. Or, if this course cannot be followed, the pipe may be safely passed through a hole bored in the middle of the joists. If this is not feasible, the indispensable notch may be cut right down to the middle of the joist, and the pipe thus laid across the neutral line; the space above being afterward filled with a tight wedge which will safely transmit the compressive stress.

Suez Canal Tolls.

One of our English contemporaries, alluding to the fact that the present Suez Canal brings in dues to the amount of about £10,000 per day, thinks there is not much doubt but that a second canal would pay well, and that shipowners would only be too glad to have two passages through the Isthmus; for to say nothing of the gain of time owing to their being less traffic through each, the two canals would compete with each other, and the mutual reaction would, as in the case of two railways to the same place, make the rates go down. No nation has a tithe of the interest England has in the undertaking, and he hopes our commercial magnates will not so long delay in obtaining the necessary concession as to enable some other nation to step in and bear it off before them.

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ENGINEERING INVENTIONS.

A car brake, which can be adjusted so that it will be applied automatically by the bumping together of the cars, is the subject of a recent patent granted to Mr. J. B. O'Donnell, of Hazleton, Pa. The drawhead is operated by a lever so arranged as to be acted upon by the drawhead.

Mr. H. M. Neff, of Denver, Colo., has recently secured a patent on improvements in sleeping cars, in which the berths and seats can be folded very compactly, so as to occupy but very little space when not in use, and by his simple arrangements the berths may be prepared and taken down much more rapidly than in most sleeping cars now in use.

A car brake to utilize the momentum of the cars to apply the brakes has recently been patented by Mr. C. A. Millener, of Deseronto, Ontario, Canada. The construction of this brake is exceedingly simple, and is so arranged that either the engineer or a brakeman in the caboose of freight trains can release or apply the brake at will.

Mr. G. M. Bedinger, Jr., of Erlanger, Ky., has patented an electric signaling apparatus for railway trains, the object of which is to provide for telegraphing between trains, or from a central station to any train on the line, so that all the trains may be under the control of one person at the central station, lessening the danger of irregularity in the movement of the trains and consequently preventing accidents.

Mr. Daniel Spangler, of Hanford, Cal., has received a patent for improvements in channeling rivers and navigable streams. The object of the invention is to restrict to a given course the channels, whereby not only submerged land may be reclaimed, but a fixed channel is available for navigable purposes, and the destruction of property consequent upon inundations is avoided.

A very simple and inexpensive car coupling is the subject of a patent granted to Mr. W. D. Sandwich, of Montgomery, Ala. This consists of a rotary head provided with a coupling pin, and formed with a series of notches for locking the head. The rotary head is turned automatically upon its pivot for coupling by the entrance of the link into the drawhead. The rotating head is held in coupled position by means of a pawl, which drops into one of the series of notches in the head, according to the relative height of the cars.

MECHANICAL INVENTIONS.

Mr. John Lynch, of Alleghany City, Pa., has recently patented an improvement in furnaces for assaying and refining metals, the special novelty of which consists in the mode adopted for supporting, adjusting, and handling the cupel.

Mr. E. P. H. Capron, of Hudson, N. Y., has patented a simple and ingenious friction clutch, the object of which is to facilitate the locking of pulleys and wheels upon their shafts and the releasing of them, and to prevent the shafts from being cut or worn by the clutches.

Mr. F. H. Gross, of Deer Isle, Me., has patented an automatic sash holder to be jointed or attached in a swinging manner to the sash and bear against the window frame, to automatically hold the sash in any position to which it may be raised or lowered.

A patent for improvements in cutter heads and knives of rotary planers has recently been granted to Mr. A. V. Cross, of Williamsport, Pa. The knives are made with opposite cutting edges, so that when worn too much on one edge they can be reversed, thus utilizing the knife to its fullest extent.

A labor saving hand drilling machine of simple and convenient construction has recently been patented by Mr. Jacob Cherney, of Denver, Colo. This drill is adjustable for boring either horizontal or vertical holes by bringing into play a lever attachment, easily enabling one man to accomplish the whole work of hand drilling without the assistance of a helper.

An improved method of uniting the ends of driving belts has been patented by Mr. Carl Eibee, of Brooklyn, N. Y., which consists in joining the two ends of the belt by means of several pairs of screw clamped metal plates, each pair being on either side of the belt and held together by screws which extend through both clamps, securing the belt between them.

Mr. W. F. Martin, of Dannemora, N. Y., has patented a labor saving machine for beating up napped hats or removing the cotton which in the process of manufacturing is mixed with the fur. By the aid of reciprocating beaters and a moving bed this result is accomplished to the great saving of hand labor, which is the usual way of finishing.

An apple mill, simple in form, cheap in construction, at the same time well calculated for efficiency and durability, has recently been patented by Mr. J. F. Patterson, of Dunmore, W. Va. The entire mill is made of wood, not only on account of economy, but also that no metal shall come in contact with the juice which frequently causes injurious results.

A combined can, pump, and measure for providing retail dealers a more economical and safer apparatus for dealing out liquids than at present in use has recently been patented by Mr. B. F. Myers, of Hunnewell, Ky. The invention consists of a can containing a float and a measuring scale. The liquid is forced from the barrel by aid of a pump through the measuring vessel.

Mr. Arthur Felber, of Nyack, N. Y., has recently received letters patent for improvements on his patent issued November 14, 1882, for a stop motion for button hole sewing machines, whereby he has so simplified the construction that a single operator can run four machines at the same time. By an ingenious automatic stop mechanism, the machine stops itself when each button hole is finished.

A fire escape has been recently patented by Mr. H. D. Eastman, of Minneapolis, Minn. The apparatus is so arranged that it may either be attached permanently to buildings, or made portable by mounting on wheels and constructing in two sections hinged together. An endless chain carries buckets or cars for the removal of merchandise or people, and the frame is so arranged that it can be used as a water stand pipe.

A novel canning press, designed to be used in factories where steam power is employed, has been patented by Mr. Lucius Hamlin, of Sebago Lake, Me. The invention consists of a press with contrivances to facilitate the filling of cans with food substances, and a follower to pack the same into the cans, which is operated by a pneumatic vacuum produced by a steam ejector.

Mr. G. W. Hill, of Stark's Point, Wash. Ter., has patented a file handle, contrived with attachments for enabling it to be used for jointing, setting, and gauging the teeth of the saw. It is also provided with a straight edge and lineal measure, so the implement embodies all the necessary devices for enabling the woodman to carry with him the means by which to keep his saw in order.

Mr. E. A. Darling, of Hartford, Conn., is the patentee of a surface gange for the use of metal workers and others in marking out work. Provision is made for a more convenient final vertical adjustment of the upright or standard carrying the marking point. This gauge it is believed will supersede those now in use, the inventor claiming that they are much less complicated and cheaper to make.

A machine for separating and preparing the fibers of jute and other plants for use in the manufacture of paper and bagging, etc., is the subject of a patent by Mr. T. J. Spear, of New Orleans, La. The process consists in passing the plants between a series of plain and corrugated rollers that the plants and the stalks may be crushed and flattened and the juice pressed from them. After the plants have been passed through the machine they are set aside to rot for ten or twelve days, after which the matter will be ready to be manufactured.

Among the recent inventions relating to improvements in cotton machinery is the elevator and distributer of Mr. A. D. Thomas, of Morrillton, Ark. In this machine an endless elevator is provided for raising the seed cotton from the wagon on to the carrier, by which it is transferred either directly into the gin or to the bins for storage. A supplementary transferable elevator is provided to raise the cotton from the bins on to the carrier for delivery into the gin. This is a great labor saving machine, as this sort of work has heretofore generally been done by hand.

To facilitate the operation of sizing, scalding, and sticking hat bodies, an improved machine has been patented by Mr. G. F. Larkin, of Danbury, Conn. A tank is constructed with ribbed plates inclined from each other, and kept in place by guides, whereby the rolls of hat bodies placed between these plates will be rolled with a movement similar to the manipulation by hand. The goods are placed on the bend of an apron while being worked, so that they may be readily removed from the tank without the necessity of the operator putting his hands in the hot water.

A mouthpiece in which the size may be varied to suit the requirements of the different performers on the cornet or similar wind instruments without changing the pitch has been patented by Mr. H. E. Jones, of Caribou, Me. The tube of the instrument is fitted with an inner tube provided with a cup that fits closely within the mouthpiece of the instrument. The inner tube is provided with a screw thread, and by turning the tube the supplementary cup will be moved within the mouthpiece, thereby increasing or diminishing its size.

Mr. E. S. Williamson, of Bradford, Pa., has patented an apparatus for pumping and flowing oil wells, which is an improvement upon a patent granted to him in August, 1882. The apparatus consists of two tubes, one inside of the other, and the improvement relates principally to the method employed of anchoring the outer tube to the sides of the well, and in placing the packing box for the working tube nearer the bottom of the well than was possible in the first invention. When the oil will not flow naturally to the surface it is forced up, and will be discharged from the top of the hollow tube by moving this tube up and down for that purpose.

An improved apparatus for extracting grease from wool has been patented by Mr. A. H. Butel, of Bridgeport, Conn. The material to be operated upon is first placed within a rotating cage, after which it is lowered into a tank containing liquid hydrocarbons and other suitable solvents, and after the material has been sufficiently immersed by the rotation of the cage in the liquid, it is taken out and passed through a wringing machine, when the material is spread out and dried. The liquid, however, is drawn from the tank into a still for the purpose of separating the oil from the liquid, the volatile oil passing away by evaporation into a condenser, whence it is drawn into an oil tank. Thus the machine accomplishes two useful purposes, cleansing the wool and preserving its oil.

Improvements in the machinery and the method of shrinking, drying, and finishing cloth has been patented by Mr. William Hebdon, of New Brighton, N. Y. The advantages of this invention consist in the continuity and rapidity of its operations, the uniformity in the dampening and shrinking, and in the thoroughness with which the cloth is dried and finished. The dampening, shrinking, drying, and finishing may all be carried on at the same time. The nap may be laid and a beautiful finish given to faced goods by passing them fag end foremost over heated metallic surfaces. The middle crease in the cloth is removed, so that in doubling it for cutting the selvages may be placed edge to edge, and the cloth cut to the best possible advantage. The same inventor has also patented a machine for measuring cloth, which is an improvement upon a patent granted to him June 18, 1878. This consists in arranging a series of rollers in such a way in a frame that as the cloth passes over them it will be subject not only to an easy examination, but by rotating one of the rollers over which it passes the amount of cloth will be automatically measured, and the result indicated on a dial or marking index connected with the said roller.

MISCELLANEOUS INVENTIONS.

Mr. F. E. Bundy, of Elmira, N. Y., has received a patent for a hat holder made of wire or narrow strips of metal, which can be carried in the pocket and hung on chairs in theaters, churches, halls, etc.

Mr. Jean B. Rolland, of Paris, France, has patented a traveler for ring spinning frames, which is designed to regulate the tension of the thread in a new and improved manner, while being spun.

A simple safety snap hook, which is so constructed that the bolt or plunger cannot be pushed back by the horse, thus preventing the accidental opening of the hook, has been patented by Mr. Henry Straw, of Guilford, Me.

Mr. J. B. Dunwody, Jr., of Walterborough, S. C., has patented an improved shutter bower which consists of a spring bar connecting the two blinds across the window, constructed so that the blinds swing open or are shut by the leverage of the spring bar.

Mr. Charles L. Crum, of Winchester, Va., has patented a novel cask out of the ordinary straw or paper pasteboard. These are so constructed that they may be readily taken to pieces for transportation, and as readily put together again when required for use.

Mr. Hans M. Carlsen, of Cleveland, O., has invented a new and improved binding pole and chain, used on wagons for securing the load in place in a more effectual manner than by similar devices heretofore employed.

Mr. August Schulze, of New York city, has received a patent for a hand mirror holder for toilet cases, intended to provide hand mirror holders with a case constructed in such a manner as to receive and hold securely hand mirrors of various shapes and sizes.

A patent has been issued to Mr. Franz Zander, of New York city, for improvement in boxes for toilet sets, which consists in an arrangement of springs in such a manner in the top of the box as to hold a mirror of any shape, without changing the construction.

A horse collar pad has recently been patented by Mr. W. J. Cochran, of Denison, Iowa. He surrounds the galled place with a wall of padding on all sides, admitting air through holes in the pad, which keeps the galled part cool and at the same time keeps off flies.

A fence, cheap, light, and secure against hogs and other animals, has been patented by Mr. Madison Dagger, of Newtown, Ind. The invention consists in a worm rail and wire fence in which double posts and cross stakes are used, producing a very superior fence at limited cost.

A very simple device for fastening the heads and bottoms in barrels has been patented by Messrs. F. Le R. Tetamore and S. E. Fordham, of Brooklyn, N. Y. This fastener consists in a metal-shaped piece, which receives the head and bottom of the barrel and holds them securely in place.

A combined tobacco box and match safe has been patented by Mr. William Riley, of New York city. The match receptacle is located on the top of the tobacco box, and the contents of both the match and tobacco compartments are simultaneously exposed on raising the cover of the latter.

A very convenient artist's box for holding paints, brushes, and other artists' materials has been patented by Mr. W. H. Brownell, of Brooklyn, N. Y. It is arranged so that an easel can be formed of the top, and it is furnished with a strap to confine it to a person's knee while sketching where a table or other support is not within reach.

An improved harness bridle has been patented by Mr. J. J. McCue, of Nashville, Tenn., which consists of a metal crown plate formed with a fly terret, loops, guide, crosspieces, etc. The buckle for guiding the check reins and the crown piece being cast and attached to the head piece by screws, it can be put on quickly, and easily adjusted, and requires no stitching.

A novel device for fastening bows or neck ties in place has been patented by Mr. W. A. Bates, of Princeton, Me. This consists in providing the bow at the back with a flexible tube, which in use passes over the button and is retained thereon by its elasticity, the outer end being closed, so that suction shall assist in holding the tube in place upon the button.

A simple holder for exhibiting hose, so that one or more of the number may be removed without disturbing the rest, has been patented by Mr. O. W. Conner, of Wabash, Ind. The object is to enable the store keeper to display a large variety at a time, so that any pair of hose selected by the purchaser may be taken from the holder without disturbing the others.

A device to be applied to the window sashes of carriages to prevent the rattling and jarring of the same has been patented by Mr. B. Hurtubes, of Rahway, N. J. This consists in applying to each vertical edge of the window sashes a rubber tube stiffened by a metallic bar. It is claimed of this buffer that it will prevent all noise and jar of the windows.

Mr. Stephen Coutant, of Kingston, N. Y., has patented an apparatus for dressing and finishing bricks before burning, which work heretofore has generally been done by hand. The invention consists in a frame, carrying finishing and pressing rollers, which are caused to move over the bricks, removing all imperfections.

A very simple lace fastener to be applied to shoes, gloves, and other similar articles is the subject of a patent granted to Mr. H. H. Porter, of Littleton, N. H. This device consists in an eyelet provided with a transverse bar, whereby, by passing the cord through the eyelet over the bar and back through the eyelet again, it is firmly held at any desired point in the length.

A novel device for preventing cattle from straying on to railroad tracks or passing into or out of an inclosure at a point where the fence is terminated by the track has been patented by Messrs. B. J. Dillon and A. Gartner, of Savannah, Ga. This cattle guard consists in placing a series of spiked rollers upon frames which may be located between and on both sides of the track at points where cattle are likely to pass, preventing their crossing the track. Its use also obviates the construction of pits customarily used by railroad companies.

An improved spike, so constructed as to be firmly held in the timber in which it has been driven, has been patented by Mr. Abram Wakeman, Jr., of New York city. A hole extends through the head down through the body, and terminates in a curve at the side of the spike. By driving a pin through this hole it will be bent and curve into the timber almost vertically to the spike, making it fast in the timber.

A very handy and useful implement for transplanting rose bushes and small plants without disturbing the roots has been patented by Mr. John M. Lindsey, of Crystal Springs, Ga. Two spoon-shaped scoops attached to handles and pivoted together are forced into the ground each side of the plant, so that when closed they inclose the roots and the surrounding earth, enabling both to be removed together.

Mr. Ambrose Huttinger, of Liverpool, O., has patented a stove pipe fastener which consists of a hook lever pivoted on the side of the pipe, and a rod extending along a groove in the side of the pipe and through the pipe hole to engage with the chimney. The hook is provided with a toothed rack and a spring pawl for holding it, and the rod is extensible, so as to connect equally with a thin stove plate or a thick chimney wall.

An improved trunk strap has been patented by Mr. J. W. Putnam, of New Orleans, La. This strap instead of being made of leather is made of a woven webbing with a looped end, which is furnished with an adjustable buckle frame, whereby the length of the strap may be altered according to the size of the trunk. This strap may be used for any size of trunk or box, and does not become stiff and difficult to handle from being wet.

A substantial platform gear for heavy trucks has been patented by Mr. Edward Clark, of New York city. The inventor uses helical springs as being capable of supporting greater weight in proportion to the amount of metal than those ordinarily in use. Leaf springs may also be used as a support for the gear if desired. By this improvement a very substantial gearing will be provided with the use of very little metal.

An artificial cork has been patented by Messrs. Carl Grunzweig and Paul Hartmenn, of Ludwigshafen, Germany. The invention consists in mixing powdered cork with starch and water, and kneading the mass while boiling hot until it is thoroughly mixed. This should then be poured into moulds for forming the articles, and afterward dried at a very high temperature. The composition provides an excellent substitute for native cork, is quite light, and possesses non-conducting properties.

Mr. A. G. Forster, of New York city, has patented some improvements in swings for children in which a device is provided for preventing the child from falling out of the same. This consists in a front bar which is hinged at one end to the seat arm of the swing, and secured at the other end and at the center by pins which are provided with spring catches for fastening the pins in place automatically. The invention further relates to the manner of fastening the swing to the ceiling or beam.

An improved spring bed bottom, so constructed as to enable the folding of the bed and to facilitate the storing and transporting of the same, has been patented by Mr. John McPeck, of New York city. The bed frame consists of two series of slats held apart by interposed springs, while they are separated laterally by cross slats. The upper longitudinal slats at the sides of the bed are slotted, so that they may be slid together to decrease the length of the bed bottom.

Mr. J. H. Dumont, of New York city, has received letters patent for an improved railroad express indicator. This is triangular in form and is provided with suitable slots in which are inserted iron plates which have perforations in the form of letters and numbers, by means of which the time of departure of the trains and like information may be communicated. The indicator is provided upon the inside with a lamp, by means of which the slides will be visible by night as well as day.

A novel construction of springs for two wheel vehicles has been patented by Mr. Harry Watts, of Knightstown, Ind. The seat of the wagon is supported upon coiled springs, the lower ends of which are attached to the axle of the vehicle, while the other ends of the springs instead of terminating at the seat extend forward and connect with the shafts, whereby the objectionable back and forth motion given to the carriage by the horse's shoulder is neutralized. Rubber cushions are placed between the springs and the shafts at the point of juncture.

An improvement in bowls for water closets has been patented by Mr. J. J. B. Frey, of New York city. Connected with the bowl is a slop safe which forms an integral part of the water closet bowl, thus avoiding multiplicity of parts. The slop safe as well as the bowl is furnished with a flushing rim or duct, each being supplied with water by its individual pipe. The bowls are of porcelain or earthenware, and being constructed of one piece, they occupy much less space, cost less, and otherwise possess advantages over the ordinary system of arranging water and slop closets. This invention is an improvement on a patent granted to Mr. Frey in July, 1882.

An apparatus for electric telegraphy to be used by persons unskilled in the use of ordinary transmitters has been patented by Mr. P. E. Perez, of New York city. A suitable table is provided in which are placed signal plates of metal, each plate being made to correspond with a letter of the Morse alphabet. A non-conducting material is placed between each plate to form a suitable space between each letter. Metal strips are employed to hold down the plates upon the table. A stylus is provided consisting of a non-conducting handle fitted at one end with a metal roller which is connected with the wire from the end pole of the electric telegraph circuit. By passing this transmitter over the whole row of plates as set the message will be transmitted and will be taken down by the ordinary Morse register at the other end of the circuit.

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Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Best Squaring Shears, Tinners', and Canners' Tools at Niagara Stamping and Tool Company, Buffalo, N. Y.

Lewis' Combination Force Pump makes three machines made of brass throughout. See Adv. page 317.

Saw Mills, Hauck & Comstock, Mechanicsburg, Pa.

Wanted, Superintendent for Malleable Iron Works. Address "Y," P. O. Box 773, New York.

Wanted, man who understands making the mandrels, and turning all kinds of furniture springs; give reference and experience. Address A. B., P. O. Box 3,621, New York.

Am. Twist Drill Co., Meredith, N. H., make Pat. Chuck Jaws, Emery Wheels, Grinders, automatic Knife Grinders.

American Fruit Drier. Free Pamphlet. See ad., p. 318.

Drop Forgings of Iron or Steel. See adv., page 316.

Brass & Copper in sheets, wire & blanks. See ad. p. 318.

The Chester Steel Castings Co., office 407 Library St., Philadelphia, Pa., can prove by 20,000 Crank Shafts and 15,000 Gear Wheels, now in use, the superiority of their Castings over all others. Circular and price list free.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Diamond Drills, J. Dickinson, 64 Nassau St., N. Y.

Tight and Slack Barrel Machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv. p. 317.

Gear Wheels for Models (list free); Experimental Work, etc. D. Gilbert & Son, 212 Chester St., Phila., Pa.

Drop Hammers, Power Shears, Punching Presses, Die Sinkers. The Pratt & Whitney Co., Hartford, Conn.

Catechism of the Locomotive, 625 pages, 250 engravings. Most accurate, complete, and easily understood book on the Locomotive. Price $2.50. Send for catalogue of railroad books. The Railroad Gazette, 73 B'way, N.Y.

20,000 Duc Spherical Elevator Buckets, sizes 3½ to 17 inches, constantly on hand. Telegraphic orders filled. T. F. Rowland, sole manufacturer, Brooklyn, N. Y.

First Class Engine Lathes, 20 inch swing, 8 foot bed, now ready. F. C. & A. E. Rowland, New Haven, Conn.

Catalogues free.—Scientific Books, 100 pages; Electrical Books, 14 pages. E. & F. N. Spon, 44 Murray St., N. Y.

Straight Line Engine Co., Syracuse, N. Y. See p. 317.

For Pat. Safety Elevators, Hoisting Engines, Friction Clutch Pulleys, Cut-off Coupling, see Frisbie's ad. p. 300.

For Mill Mach'y & Mill Furnishing, see illus. adv. p. 300.

See New American File Co.'s Advertisement, p. 302.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p. 302.

Woodwork'g Mach'y. Rollstone Mach. Co. Adv., p. 300.

Steam Pumps. See adv. Smith, Vaile & Co., p. 300.

Stenographers, type-writers, clerks, and copyists may be obtained free of charge at the Young Women's Christian Association, 7 East 15th Street, New York.

Ejector Condenser for Steam Engines or Vacuum Pans. J. L. Alberger, Buffalo, N.Y.; or T. Sault, New Haven, Ct.

Lathes 14 in. swing, with and without back gears and screw. J. Birkenhead, Mansfield, Mass.

Five foot planers, with modern improvements. Geo. S. Lincoln & Co., Phœnix Iron Works, Hartford, Conn.

The Best.—The Dueber Watch Case.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40. Various other foreign patents may also be obtained. For instructions address Munn & Co., SCIENTIFIC AMERICAN Patent Agency, 261 Broadway, New York.

Curtis Pressure Regulator and Steam Trap. See p. 286.

The Celebrated Wooton Desk. See adv., page 286.

Lightning Screw Plates, Labor-saving Tools, p. 286.

Wanted.—Patents or the right to manufacture the articles on royalty. Give full particulars. Cuts, drawings and specifications will be returned, if not in our line, on request of parties sending same. Lock Box 35, West Troy, N. Y.

Farley's Directories of the Metal Workers, Hardware Trade, and Mines of the United States. Price $3.00 each. Farley, Paul & Baker, 530 Market Street, Phila.

Correspondence solicited from parties desiring brass or bronze castings. Special facilities for large and heavy work. Lock Box 35, West Troy, N. Y.

Improved Skinner Portable Engines. Erie, Pa.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Boiler Scale.—Parties having fine specimens for sale or loan, address Jas. F. Hotchkiss, 84 John Street, N. Y.

Permanent Exposition.—Inventors' Institute, Cooper Union, N.Y. City. Every facility for exhibition of machinery, merchandise, and inventions. The expense is small—the advantages great. Send for particulars.

Contracts taken to manuf. small goods in sheet or cast brass, steel, or iron. Estimates given on receipt of model. H. C. Goodrich, 66 to 72 Ogden Place, Chicago.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, polishing compositions, etc. Complete outfit for plating, etc. Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

Lists 29, 30 & 31, describing 4,000 new and 2d-hand Machines, ready for distribution. State just what machines wanted. Forsaith & Co., Manchester, N. H., & N. Y. city.

"Abbe" Bolt Forging Machines and "Palmer" Power Hammers a specialty. Forsaith & Co., Manchester, N.H.

Railway and Machine Shop Equipment.
Send for Monthly Machinery List
to the George Place Machinery Company,
121 Chambers and 103 Reade Streets, New York.

25" Lathes of the best design. G. A. Ohl & Co., East Newark, N. J.

"How to Keep Boilers Clean." Book sent *free* by James F. Hotchkiss, 84 John St., New York.

Engines, 10 to 50 horse power, complete, with governor, $250 to $550. Satisfaction guaranteed. More than seven hundred in use. For circular address Heald & Morris (Drawer 127), Baldwinsville, N. Y.

Wanted.—Patented articles or machinery to make and introduce. Gaynor & Fitzgerald, New Haven, Conn.

Water purified for all purposes, from household supplies to those of largest cities, by the improved filters manufactured by the Newark Filtering Co., 177 Commerce St., Newark, N. J.

Latest Improved Diamond Drills. Send for circular to M. C. Bullock Mfg. Co., 80 to 88 Market St., Chicago, Ill.

For Power & Economy, Alcott's Turbine, Mt. Holly, N. J.

Ice Making Machines and Machines for Cooling Breweries, etc. Pictet Artificial Ice Co. (Limited), 142 Greenwich Street. P. O. Box 3083, New York city.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Machinery for Light Manufacturing, on hand and built to order. E. E. Garvin & Co., 139 Center St., N. Y.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

Supplement Catalogue.—Persons in pursuit of information on any special engineering, mechanical, or scientific subject, can have catalogue of contents of the SCIENTIFIC AMERICAN SUPPLEMENT sent to them free. The SUPPLEMENT contains lengthy articles embracing the whole range of engineering, mechanics, and physical science. Address Munn & Co., Publishers, New York.

NEW BOOKS AND PUBLICATIONS.

REPORT OF THE CHIEF OF ORDNANCE FOR 1882. Government Printing Office.

In this summary of the condition of his department for 1882, General Benet speaks of the Springfield breach loading rifle as having no superior for army uses, and expresses the belief that it will hold its place until it is superseded by a magazine gun. Of this class of rifles submitted for examination there were forty guns, representing different systems of detachable and fixed magazines. After tests extending over a period of fifteen months, only three were recommended as "suitable for military service"—the Lee, the Chaffee-Reece, and the Hotchkiss. In view of the appointment of a select committee on heavy ordnance for the navy and seacoast defenses, General Benet says that "full power" guns must be made of steel. An improvement on the present ordnance can be made, however, by using cast iron guns with a rifled tube of steel, the barrel to be wound exteriorly with steel wire. He doubts if steel guns can at present be produced in this country—guns of the requisite caliber made entirely of steel—as we have neither the suitable plant nor the means of producing the steel in the necessary masses. He suggests either the establishment of a national foundry, or encouragement to private foundries to procure the necessary plant and experience. The report is illustrated with plates and contains several instructive and useful tables.

TECHNOLOGISCHES WORTERBUCH—TECHNOLOGICAL DICTIONARY—IN ENGLISH AND GERMAN. Gustav Eger, Brunswick. Frederick Vieweg & Son, B. Westermann & Co., 838 Broadway, New York city.

This is an octavo volume of over 700 pages containing words, terms, and phrases, of a colloquial and technical character, giving the German equivalent for the English subject. Among the titles are: Architecture, shipbuilding, railways, roads, bridges, mechanics, manufacture, agriculture, navigation, mining, and the sciences connected with the arts. The volume makes a valuable and convenient reference book.

THROUGH ONE ADMINISTRATION. Frances Hodgson Burnett. Boston: James R. Osgood & Co.

Those who have patiently accepted the installments of this story as they have periodically appeared, may be glad to have it in complete and usable form for ready reference; for, unlike some writings which are only stories, the delineations of character and relations of incident by this author invite a revision and re-reading. Those who have not yet read this attractive novel will now be paid for their reticence by the appearance of this volume, which is of just a handy size for the traveling bag or reticule, and adapted to the inviting laziness of the seashore or the cool silence of the forest.

DEEP BREATHING AS A MEANS OF PROMOTING THE ART OF SONG, AND OF CURING WEAKNESSES AND AFFECTIONS OF THE THROAT AND LUNGS, ESPECIALLY CONSUMPTION. Sophie Marquise A. Ciccolina; from the German by Edgar S. Werner. New York: M. L. Holbrook & Co.

The object of this little treatise is to restore as an art a perfectly natural physiological habit, that of deep breathing, or of inflating the abdomen as well as the lungs with atmospheric air. The directions are the results of efforts made to restore a lost voice, to enable one with natural vocal powers to sing. She claims that the public life of artists can be greatly prolonged, that persons of "weak" voice can become singers, that the general health can be improved by a voluntary practice of deep breathing, such as is seen in the sleeping infant and in the adult when excited by coughing, retching, etc. The ultimate result of this practice, on the author, and its good effects on others, who adopted it by her advice, seem to be conclusive as to its benefit. These facts are contained in a small volume of about fifty pages, to which our readers are referred for the *modus operandi*, which is illustrated by diagrams.

A MANUAL OF PHOTOGRAPHIC CHEMISTRY, THEORETICAL AND PRACTICAL. By Rev. T. Frederick Hardwich, M.A. Ninth edition. Edited by J. Traill Taylor, Ed. *Photographic Times*. New York: Scovill Manufacturing Co., 419 Broome Street.

The usefulness of this treatise as a manual for photographers may be inferred from the publication of a ninth edition. In addition to its information for the professional and the amateur photographer, this volume contains, also, an interesting history of photography and a chapter of outlines of general chemistry. In its descriptions of the details of the practice of photography, this manual does not confine itself to one method, but gives several processes and explains the reasons why some, or one, should be preferred.

MYSTERIES OF TIME AND SPACE, WITH TWENTY-FOUR ILLUSTRATIONS. Richard A. Proctor. New York: R. Worthington, 770 Broadway.

This is the title of a collection of twenty-four essays by Mr. Proctor, the well known popular writer and lecturer on astronomy. That they are intensely interesting need not be stated to those who have either heard Mr. Proctor's public addresses, or who have read only the newspaper reports, which have necessarily been abstracts, or at most merely synoptical. Mr. Proctor has a faculty of presenting the results of wearisome calculations, not merely in dictatorial statements, but with a foundation of mathematical and historical fact that carries conviction. For instance, in the opening essay he elucidates the astronomical fact of the gradual retardation of the period of the earth's rotation, by history and observation, so that what might before have been accepted as a true statement becomes appreciated as a proved fact. In his essay on the "Birth and Death of Worlds," Mr. Proctor finds actual illustrations in the solar system of the five stages, earth at present occupying the middle or third one. The sun represents the first stage of planetary life, that of existence in the form of vapor—the hardest minerals and most obdurate metals being held in a gaseous, glowing state by intense heat. Jupiter is an example of a world the nucleus of which has become solid, but which holds its oceans suspended in its atmosphere. Jupiter is in the second planetary life stage and will not be in the third, or earth stage, for 240 millions of years. The earth represents the third, or life-producing stage. Mars is in old age, or decreptitude; and the moon is essentially a dead world, a condition which earth will reach in about 200,000,000 years.

THE POSSIBILITY OF NOT DYING; A SPECULATION. Hyland C. Kirk. New York: G. P. Putnam's Sons.

This little volume of scarce more than 100 pages attempts to give some speculations on the possibility of a continuous physical existence. The "speculations" are curious and interesting, and whatever they may tend to prove or disprove, the writer appears to be animated by his statement in the preface: "The chief conservator of morality in this life is religion. No one, therefore, has the right to attempt the destruction of those barriers which protect society, unless he has stronger methods of defense to substitute therefor."

THE FRENCH FOREST ORDINANCE OF 1669; WITH HISTORICAL SKETCH OF PREVIOUS TREATMENT OF FORESTS IN FRANCE. John Croumbie Brown, LL.D., Compiler and Translator. Edinburgh: Oliver & Boyd.

Dr. Brown has given a valuable history of the sylvan property in France, from the earliest times, in a neat volume of less than 200 pages. The object is to give practical information on the subject of the value and use of standing forests; how they may be utilized for the needs of man without being destroyed, and how they may be restored where the country has been left bald by their destruction. There are portions of this country that need the benefits of such intelligent instruction as this compilation affords.

THE CENTURY. Vol. XXV., from November, 1882, to April, 1883. The Century Company, New York.

An elegantly bound volume of between 900 and 1,000 pages looks as little like the monthly visitor that we know as *The Century* as the mature "cock of the walk" looks like the hatching dozen of eggs. The fine letter press and exquisite engravings seem much finer and more exquisite in solid backs, and *en masse*.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at the office. Price 10 cents each.

Correspondents sending samples of minerals, etc., for examination, should be careful to distinctly mark or label their specimens so as to avoid error in their identification.

(1) O. A. T.—To make a furniture polish, take turpentine (oil), one pint; alkanet root, one half ounce; digest until the liquid has become sufficiently colored; then add beeswax, scraped fine, four ounces; put the vessel into hot water and stir the contents until a homogeneous mixture is obtained. If wanted pale, the alkanet root should be omitted. 2. White: white wax, one pound; liquor of potassa, two quarts; boil to proper consistence.

(2) S. M.—The Chinese method of laundrying shirt bosoms, etc., is thus described: A rather thick starch paste is prepared, by first beating up a handful of raw starch (usually cornstarch) and a teaspoonful of fine rice flour with about one quart of water, making a liquid of cream-like consistence. A certain quantity (determined alone by personal experience) is poured into a quantity of boiling water while the latter is violently stirred with a short wooden spatula. With this the portions of the linen to be dressed are well smeared (the linen moist from wringing and the starch quite hot). Thus smeared the pieces are laid aside for a few minutes, then rubbed well between the hands, so that the paste is well distributed in the fabric. The linen is then usually dried by artificial heat. When ready for ironing, the starched portions are dampened by means of a cloth dipped in raw starch water to which has been added a small quantity—about half an ounce to the quart—of blood albumen—clarified serum of bullock's blood. The proportion of starch in this water is usually about as one to fifty of water. In ironing, the irons are first made very hot, and cooled somewhat externally just before using by momentarily plunging them into a pail of water. The irons commonly employed are what are termed polishing irons—they have the posterior edge rounded instead of angular, as in the ordinary smoothing or sad iron. Much of the fine gloss observed on shirts laundried by Chinamen is accomplished by the skillful manipulation of this "rounded edge" over the work—a manipulation very difficult to describe in words. It is most laborious work for those not accustomed to it. It not only renders the surface glossy, but imparts easy flexibility to the heavily starched fabric otherwise not attainable. Custom made shirts are usually laundried before delivery in trade at the factory, the ironing in these cases being largely performed by steam mangles, though some are hand finished. The following receipt for a laundry starch is said to produce a very fine and lasting gloss on linen without the expenditure of the amount of labor in ironing usually requisite to produce a fair appearance:

Corn starch	1 ounce.
Water, boiling	1½ pints.
Bluing	q. s.

To this when it has cooled somewhat is added and thoroughly mixed in about half an ounce of the following preparation:

Gum arabic	8 parts.
Sugar, loaf	2½ "
Soap, white curd	¼ "
Water glass ("A" sirup)	1 "
Egg albumen	4 "
Water, warm	20 "

In preparing this the first three ingredients are dissolved together in the water at boiling heat, the water glass is then added and when the mixture has cooled down to about 150° Fah., the egg albumen is put in and the whole well beaten together.

(3) G. P.—The following has been suggested as a very desirable substitute for the ordinary pastes used for mounting photo. prints. It is said that it can be used so as to scarcely swell the paper at all, avoiding the objectionable cockling so much complained of:

Thick, well boiled, clear starch (corn) paste	1 pound.
Glucose sirup ("A" clear)	7 ounces.
White curd soap	½ ounce.
Dextrine, flowered	5 ounces.
Borax	⅛ "
Clove oil	a few drops.

All are heated over the waterbath and thinned down to a proper consistence (if thin paste is required) with fresh skimmed milk. It is advisable to use the paste warm and as thick as possible.

(4) E. P. S. asks how to make matches without phosphorus? A. The following is one of the best receipts for composition match tips without phosphorus. It is the same as that used in preparing the well known U. and P. matches, and does not require a separate rubber or prepared surface:

Potassium nlorate	26 ounces.
Manganese, black oxide	25 "
Potassium bichromate	20 "
Lead cyanide	20 "
Antimony oxysulphide	20 "
Glass powder	4 "

These substances are first powdered separately and then gradually mixed into a solution of 1 pound gum in 4 pounds water, to form a thick, smooth paste; with this paste the dry wood splints are tipped, and after about eighteen hours' exposure to the air in a drying room, kept at about 80° Fah., the matches are ready for boxing. To render the matches non-absorbent of moisture, or "waterproof," they are momentarily dipped into a liquid composed of:

Shellac, best white	1 pound.
Alcohol (or wood naphtha)	1 quart.

digested together in a closed vessel for several days with occasional agitation, then strained through fine linen cloth.

(5) E. G. B.—Briefly stated, the process of rendering fabrics water resistant, yet not impervious to air, is as follows. First the cloth is put into a boiling bath composed of:

Yellow soap	¾ pound.
Water	1 gallon.

and worked through and about in this for about one hour, when it is passed through a roller wringer to press out excess of the liquid and suspended in the air for an hour or more, or until nearly dry. Next the cloth is put into a bath composed of:

Ammonia alum	5 pounds.
Water	3½ gals.

and remains therein for from eight to sixteen hours, according to the nature of the fabric and the requirements. The time of this exposure may be considerably lessened by working the cloth through a series of rolls, which cause the discharge of the absorbed liquid and admit of the reabsorption of fresh portions of the bath. Finally, after wringing out, the cloth is put through the soap bath again, and after rinsing in clean water, dried. See other similar processes of waterproofing in SCIENTIFIC AMERICAN, No. 6, vol. xlv., 1881.

(6) J. H.—Good pattern metal may be made of lead 8, antimony 2, but it shrinks in cooling. Lead 75, antimony 16, bismuth 8, does not shrink in casting. It also makes good patterns. Good red brass; 88 copper, 11 zinc. Electrotype manipulation is the deposition of metal by the galvanic batteries. Consult "Napier's Electro Metallurgy."

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(7) M. E.—Ordinary hemlock tanned sole leather may be said to be hardened without any material alteration of its nature by the following treatment. Prepare a bath as follows:

Slaked lime ½ pound.
Sal soda 2 "
Water ½ gallon.

Boil together, cool, and add:

Slaked lime ½ pound.
Water ½ gallon.

Put the leather into this for three days, then remove and put it into a bath of:

Slaked lime 3 pounds.
Water 1½ gallons.

and let it soak in this for from two days in summer to three days—or even four days—in winter. When taken out of this, pass through water heated to about 180° Fah., and then pass between heavily weighted rolls, or, if a denser material is demanded, press in a hydraulic press. When subjected to the latter, a product nearly as hard as vulcanite is obtained, but one still possessing the appearance and nature of leather quite distinctly.

(8) G. C. W. asks how to make a cheap white metal that will beat thin, same as gold leaf is beat. It is to be used for gilding on plaster of Paris. A. The common white gilding leaf is composed of tin and lead—2 parts tin, 1 part lead make a very white tough leaf. Equal parts of each is a little darker; 1 part tin to 2 parts lead is about as low as you can go with this compound and have it keep bright. There is a plastic metallic alloy described in the *Journal of the Franklin Institute*, vol. xxxix., page 55, which might be of use to you.

(9) C. C. C.—To soften sheet brass for stamping, heat to low red and quench in water. Some kinds of brass need be only heated to what is called the black heat. As the composition of yellow brass varies very much, you would do well to order your sheets annealed and of the kind used for stamping.

(10) G. E. Z. asks: How can I cut out round glasses that will not crack easily? I now heat the glasses almost to a melting point and press them out to the size required, three-fourths and one-half inch diameter, but find that heating the glass makes it very brittle. I cannot use a diamond, as they must be exactly alike, and the glass will not always break where cut, without the edge chipping. The glasses are used between two lead washers held by a nut against a boss, and are tested to 150 pounds pressure to the square inch. A. The process of stamping or pressing glass makes it brittle because of uneven cooling. The pieces can be made as tough as the nature of glass will allow by thoroughly annealing in the same manner as is done in the glass houses. You can construct a small oven, somewhat after the style of a baker's oven, or get what is called a muffle and set it in small furnace if your work is small in quantity.

(11) D. P. K.—Back draught or explosions in fire chamber are generally due to imperfect combustion at the commencement of firing, caused by accumulation of carbonic oxide above the fire, when upon opening the door it takes fire by the contact of air. At other times, when the ash pit door, and fire door are entirely closed to prevent steam making, the fire chamber will fill with carbonic oxide and will take fire upon opening the door. It is well to allow a little air through the fire door at all times. For "sun dial" see Notes and Queries, No. 3, September 30, 1882, which is correct for New York.

(12) J. O. B.—The enameling of cast iron is done by brushing upon the surface for the first coat, the following composition, of the consistency of paint: 66 parts powdered calcined flint, 34 parts borax; mix, melt, and pulverize, then add 12 parts potter's clay. Grind together in water enough to spread with a brush. Paint the work and put in a warm place to dry. For the second or glaze coat take 15 parts borax, 73 parts of powdered glass that has no lead in it. 12 parts caustic soda; thoroughly pulverize and mix with enough water to make it flow under a brush. Lightly and quickly brush a thin coat of the last mixture over the dry coat of the first mixture, and dry. Then fuse the enamel in an oven at low red heat. To tin cast iron is difficult and unsatisfactory. You can galvanize cast iron with zinc and then redip in tin, if necessary to have a tin surface. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 176, for galvanizing process, also SUPPLEMENT, 161, for zinc bath for galvanizing.

(13) E. K. asks: 1. How is resin oil made? A. Crude resin oil is obtained by heating the lower grades of resin in an iron still up to 158° to 160° C. First water, pyroligneous acid, and naphtha pass over. Then the temperature is raised to near the red heat of iron, when the resin boils, and crude resin oil distills over. 2. What percentage will it give? A. 20 to 25 per cent. 3. Is it necessary to have a copper condenser, or would an iron one do? A. Iron will answer. 4. A receipt to make yellow axle grease. Also receipt to make black axle grease. A. The following is a receipt for a thick oil grease:

1. For use in winter:

Tallow 35 parts.
Oil of resin 10 "
Olive orrape oil 65 "

2. For use in summer:

Tallow 60 parts.
Oil of resin 8 "
Olive or rape oil 40 "

The blue color is due to the dark violet tint of the oil referred to, while the yellow tint is produced by the addition of a solution of turmeric root in caustic soda.

(14) W. H. F. asks how powder is made. What is mealed powder? How is it made? A. The composition of powder varies according to the use for which it is intended; thus sporting and rifle powder has a composition equal to:

Saltpeter 74·84 per cent.
Sulphur 11·84 "
Charcoal 13·32 "

The pulverized ingredients, thoroughly mixed, without the addition of water, form "meal" powder.

(15) H. R. E. writes: In your last issue, on page 298, A. G. G. asks, What are the ingredients of Spencer's acid? I have used the following for the past nine years, with very satisfactory results, on steel and copper plates. (*a*) Dissolve 1 ounce granulated silver in 5 ounces of pure nitric acid and 5 ounces water. (*b*) Dissolve 3 ounces mercury in 5 ounces nitric acid and 5 ounces water. For strong Spencer acid take 2 ounces of (*a*), 2 ounces of (*b*), 1 ounce nitric acid, and 24 ounces soft water. Mix and keep in a dark bottle. It may be interesting to state that the above acid does not take effect on steel unless started off by touching the steel under the acid with a piece of clean zinc, when instant and rapid action takes place. It might remain on the steel plate forever without biting if the zinc is not applied.

(16) G. T. R. writes: In your issue of April 28, you gave an account of a meeting of the "Elmira Farmers' Club" to inquire into the best method of *preserving fruit trees* after being girdled by mice or rabbits. A very simple treatment by my father a number of years ago, in the State of Missouri, was wholly successful in *preventing* the girdling. About a year after he had planted a large orchard, the rabbits commenced "barking" his trees so rapidly that, unless a stop was immediately put to it, he would soon have only dead trunks. He accordingly went to work and wrapped old newspapers around those yet unbarked, commencing at the ground, and wrapping for a distance of, say, two feet up, tying the paper with an ordinary cotton string. These trees were never afterward touched by the rabbits.

(17) G. B. asks for the mode of making "neatsfoot oil." A. The ox feet—the feet and hocks of neat cattle cut off about 18 inches above the hoof—are denuded of skin and slit up longitudinally. Near the hoof is a small mass of soft fat, which is scooped out with the knife, and set aside for the preparation of the best quality of oil. The hoofs are washed in cold water, and then boiled in open pans set in brickwork, and heated by a fire beneath. A certain quantity of oil is thus boiled out of them, and when skimmed off, forms an inferior grade of neatsfoot oil. After about three hours' boiling, the tissues between the horny hoof and the last digit bone are sufficiently softened to allow of the latter being easily scooped out of the hoof with a knife. These "cores" consist of bone, gelatinous matter, and fat, and, together with small pieces of fat previously alluded to as being removed by the knife before boiling, are put into a separate pan of fresh water and all boiled together for the extraction of the oil. This forms the best kind of neatsfoot oil.

(18) M. C. B. writes: Can you tell me how to make the copper paint? A. Precipitate metallic copper out of any solution of a copper salt by introducing scrap iron into the liquid. Then mix the precipitated copper with linseed oil or varnish.

(19) H. B. writes: Having seen an article from the SCIENTIFIC AMERICAN relating to the green caterpillar, or worm which destroys so many cabbage heads, I will send you my sure cure. I put a quantity of green tansy into a barrel and add cold water, let it stand a day or two, then sprinkle the cabbage heads (using a fine sprinkler) with the liquid about twice a week. I have never found a worm on them after the third sprinkle. Continue to sprinkle, or they will come.

(20) W. asks: What is "salt of gold"? I am advised to try "an ammoniacal solution of an oxide or salt of gold," and ask your suggestions as to how I am to proceed. What is "salt of steel"? A. The chloride of gold, which is the usual commercial salt, can be used for the purpose. Salt of steel is probably a solution of steel in some acid, and may, we think, be replaced by using the iron chloride.

(21) J. V. S. writes: I find that a very reliable rubber cement which I am using evaporates so rapidly that in a short time it becomes too thick to use. I have tried thinning it with benzine; but when I put on a patch with the cement diluted with benzine, the rubber peels off the patch, leaving only the cloth sticking to the patched surface. 1. Can you inform me through your Notes and Queries how I can thin the cement without impairing its value? A. Most all rubber cements consist of rubber dissolved in either carbon disulphide, chloroform, or benzine, and you must add some one of these. 2. What is the best India rubber solvent? A. A mixture of methylated ether and petroleum spirit.

(22) J. C. McR. asks (1) for a mortar for adhering tiles to the walls of a Turkish and Russian bath, which would resist the action of heated air and steam. A. Use a mixture of commercial glycerine and finely powdered litharge. This compound will resist a temperature of 225°. 2. Also a kalsomine or paint for the walls of baths, which would resist the action of heat and steam. A. Use zinc white in dammar varnish; let it dry very thoroughly.

(23) M. Bros. write: We are trying to find a white enamel paint that will resist the action of water. We use it on the inside of a pine pail for dairy purposes. Have tried dammar varnish mixed with linseed oil, and put on four to five coats; and although it makes a nice enamel it does resist the action of water for any length of time. A. Use zinc white in dammar varnish and let dry very thoroughly before putting the liquid into it.

(24) W. A. I. asks for the best method of polishing brass work, and the best way of retaining a polish for a length of time. I am assistant engineer of one of our fire companies, and find it very difficult to obtain a good polish. I have been looking over back numbers, but cannot find desired information. A. For keeping up the polish upon your brasswork, do not scour with coarse powders. Get "electro silicon," or rotten stone; even whiting does well when the others are not at hand. Use a little kerosene oil in rubbing off the work; it does not oxidize or become acid like vegetable or animal oils. After you get the article well cleaned up, you need use only whiting for rubbing off the every day stains, and wipe off with the oily cloth. It prevents the action of moisture and air, and reduces the labor.

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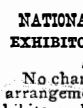
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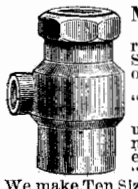
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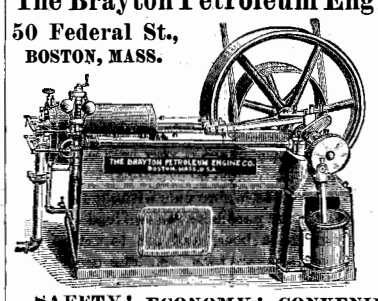
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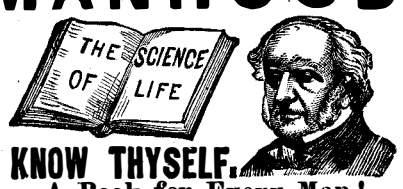

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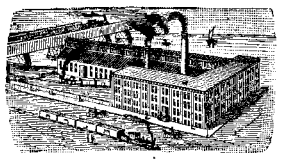

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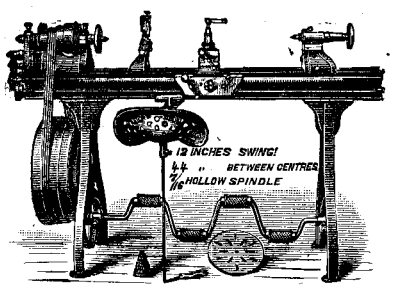

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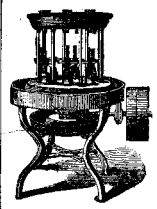

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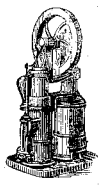

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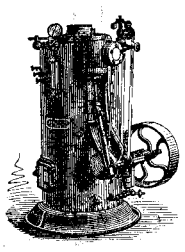

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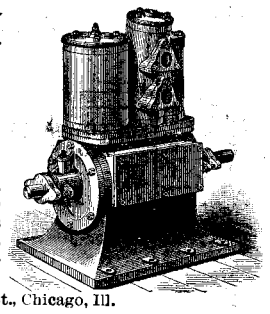

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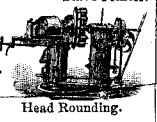

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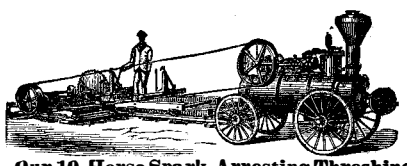

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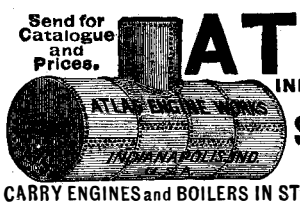

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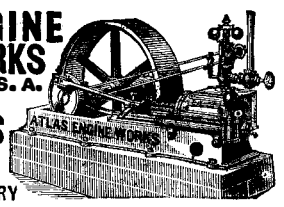

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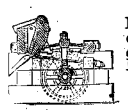

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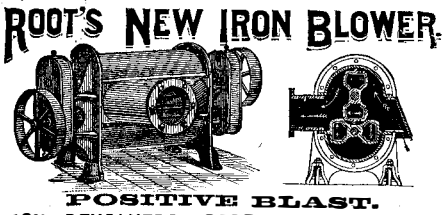

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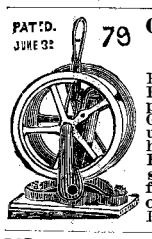

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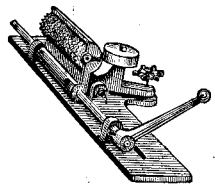

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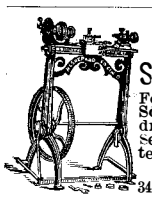

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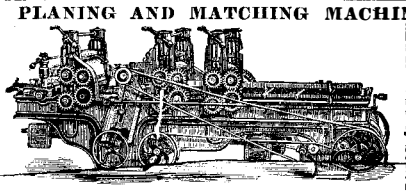

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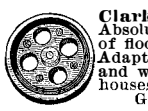

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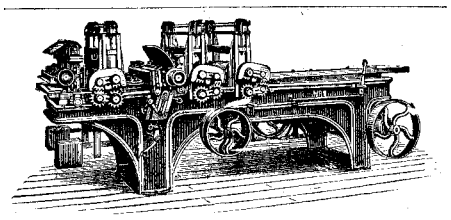

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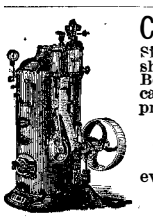

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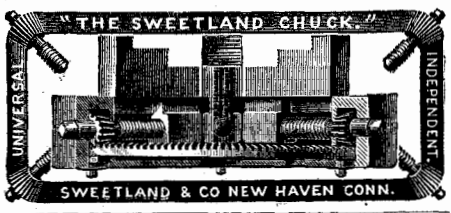

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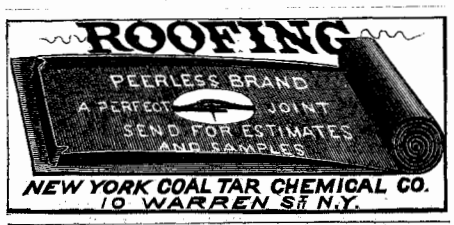

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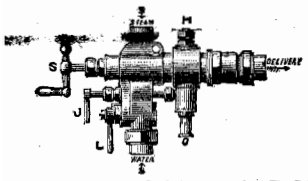

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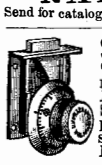

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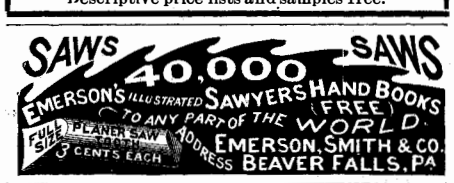
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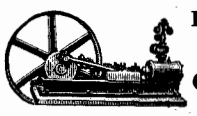

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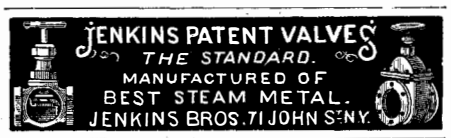

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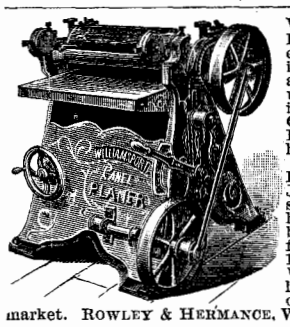

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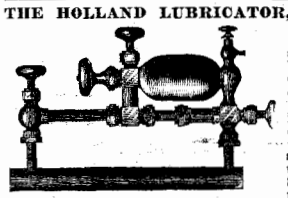

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The punches are to supply a new want of the service, being required for use in the issue of postal notes. Bidders will submit with their proposals samples of the punches offered to be furnished by them.

All proposals are to be made in accordance with the printed forms and specifications which will be furnished on application, by letter, to the "Superintendent of the Money Order System. Post Office Department, Washington, D. C.," to whom bidders should address their sealed proposals, marked on the envelope, "Proposals for Punches."

A decision on the bids will be made on or before the *sixth day of June*, 1883; the right being reserved to reject any or all of them.

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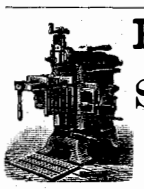

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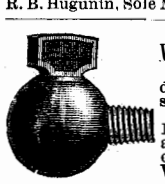

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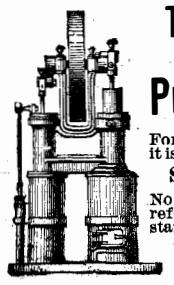

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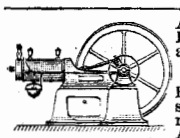

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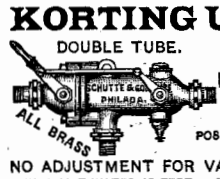

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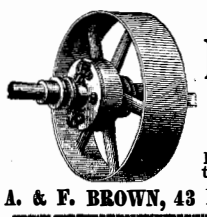

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